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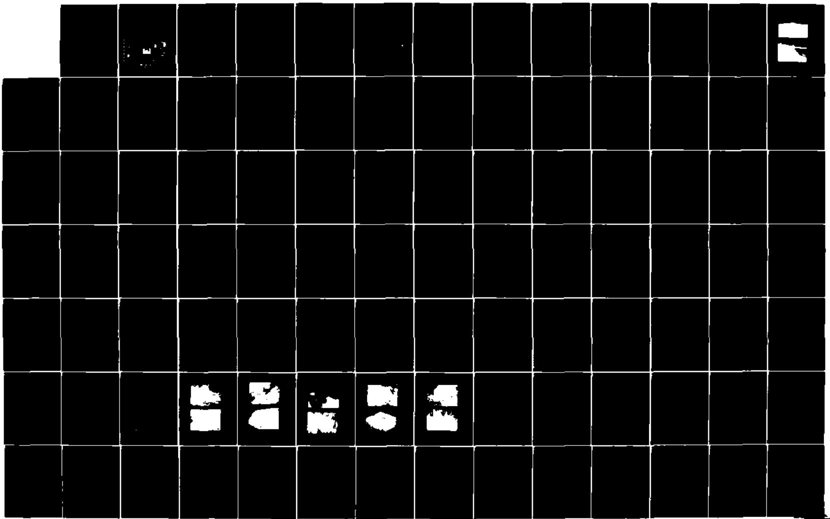

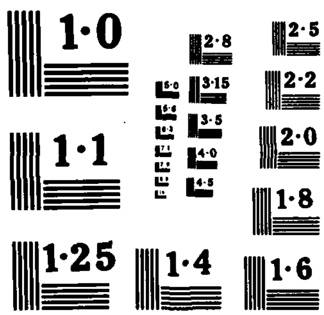
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AD-A156 876

PROVIDENCE RIVER BASIN
CUMBERLAND HILL, RHODE ISLAND

PAWTUCKET RESERVOIR DAM

R.I. 00803

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

NOVEMBER 1978

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

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Providence River Basin
Cunberland Hill, Rhode Island
Abbott Run

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earth embankment about 2900 ft. long and 33 ft. high. The dam is in good condition. Thespillway capacity is inadequate to pass the test flood outflow; it would pass about 40% of the test flood. Several seepage points were noted on the downstream slope. There are various remedial measures which must be undertaken by the owner.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF

NEDED

JAN 20 1979

Honorable J. Joseph Garrahy
Governor of the State of Rhode Island
and Providence Plantations
State House
Providence, Rhode Island 02903

Dear Governor Garrahy:

I am forwarding to you a copy of the Pawtucket Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Management, the cooperating agency for the State of Rhode Island. In addition, a copy of the report has also been furnished the owner, the City of Pawtucket, Water Supply Board, Public Works Center, 250 Armistice Boulevard, Pawtucket, Rhode Island 02860, ATTN: Mr. Robert P. Blauvelt, P.E., Chief Engineer.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Management for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

PAWTUCKET RESERVOIR DAM

RI 00803

PROVIDENCE RIVER BASIN
CUMBERLAND HILL, RHODE ISLAND

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	RI 00803
Name of Dam:	Pawtucket Reservoir (Arnold Mills)
Town:	Cumberland Hill
County and State:	Providence County, Rhode Island
Stream:	Abbott Run
Date of Inspection:	27 September 1978

BRIEF ASSESSMENT

Pawtucket Reservoir Dam is an earth embankment about 2,900 ft. long, 18 ft. wide at the crest, with a maximum height of about 33 ft. The East Dike is a smaller dam of similar construction. The main dam has a massive concrete spillway 151 ft. long which has been fitted with 2 ft. flashboards. The outlet works include 24 in. and 48 in. pipes controlled by 24 in. and 36 in. gate valves, respectively. The downstream 36 in. valve is stuck open but the upstream valve is serviceable. Maximum storage capacity is about 5,125 acre-ft. Arnold Mills Reservoir covers about 255 acres and is located immediately downstream from Diamond Hill Dam and Reservoir. Both dams are operated as a single water supply facility for the City of Pawtucket.

The drainage area above Diamond Hill Dam is about 8.4 sq. mi., while the drainage area above Pawtucket Reservoir Dam but below Diamond Hill Dam is about 9.0 sq. mi. Based on storage capacity, the project is classified as intermediate in size. Because both the main dam and the East Dike to Arnold Mills Reservoir are immediately upstream of extensive residential developments, several local roads, some commercial establishments and Interstate Route 295, the project has been classified as having a high hazard potential.

The dam is in good condition. The spillway capacity is inadequate to pass the test flood outflow; it would pass about 40% of the test flood. The test flood would overtop the main dam by more than 1 ft. and the East Dike by more than 2 ft.

Several seepage points were noted on the downstream slope. Both the main dam and East Dike have many mature trees growing on the embankments. There is some local erosion of the crest and downstream face riprap on the main dam. The concrete headwall to the outlet structure is seriously eroded and disintegrating.

Within 2 years after receipt of this Phase I Inspection Report, the owner, the City of Pawtucket, should retain the services of a registered professional engineer to: (1) assess further the

potential for overtopping of the main dam and East Dike; (2) assess further the significance of the seepage through the main dam; (3) determine whether repairs to the spillway structure are required; (4) design appropriate remedial works. The owner should implement a plan to correct existing deficiencies, including: (1) removal of brush and trees from embankments; (2) repair of erosion gullies and riprap; (3) repair of inoperable gate valve; (4) replacement of deteriorated outlet headwall; (5) monitor condition of spillway concrete; (6) monitor all seepage areas; and (7) develop a formal surveillance and warning plan.

Peter B. Dyson
Project Manager

Frederick Esper
Vice President

This Phase I Inspection Report on Pawtucket Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Richard F. Doherty

RICHARD F. DOHERTY, MEMBER
Water Control Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph A. McElroy

JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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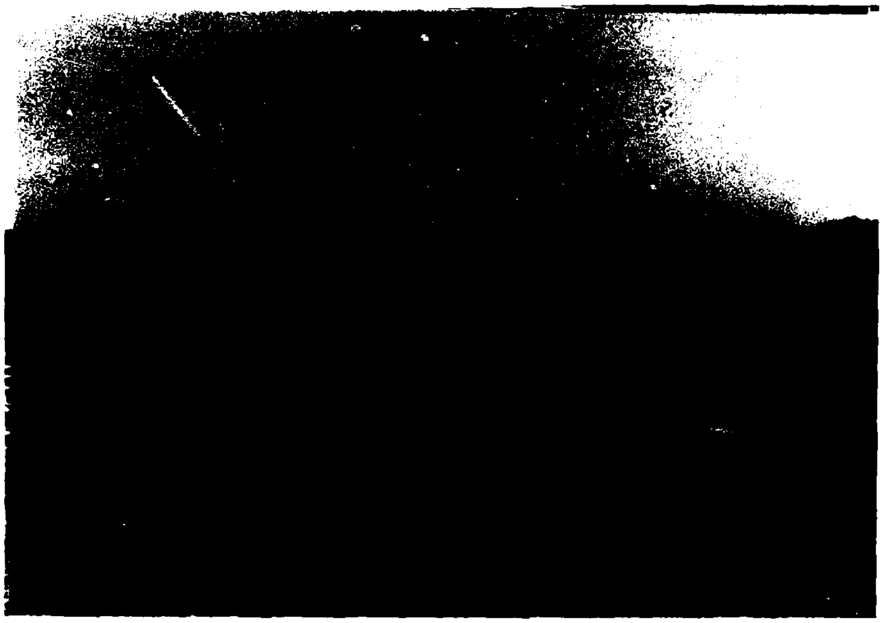
PAWTUCKET RESERVOIR DAM OVERVIEWS

(ARNOLD MILLS)



Overview of Pawtucket Dam from Diamond Hill Dam

Overview of dam from left abutment

c. Appurtenant Structures

1. Spillway

The gravity concrete spillway discharges into a stilling basin about 24 ft. below crest elevation. This basin has a concrete sill about 5 ft. high (Appendix C, Photo No. 3). The downstream surface of the section shows some deterioration, probably owing to poor workmanship in placing the concrete and improper cleanup of laitance during lift placements. Efflorescence from seeps is evident at lift junctions, and freezing and thawing effects at these junctions have apparently resulted because of seepage (Appendix C, Photo Nos. 3, 4, 5, & 7). Deterioration of concrete surfaces at the stilling basin sill block and at the downstream walls is quite general. Reinforcement is exposed at the basin sill (Appendix C, Photo No. 6). There are some loose rocks and debris in the stilling basin.

The concrete training walls downstream from the spillway structure are in generally good condition. The weep holes appeared to be functioning.

City Water Board staff stated that the flashboards on the spillway had functioned to store water above the spillway in about 2 out of 3 years, but that the flashboards were never overtopped since the practice was started in 1928. No operating bridge is provided and there is no means of access to the boards except along the spillway crest. Once water was against or overtopped the flashboards, there would be no means of removing them until water receded below spillway crest level.

2. Outlet Structure

The outlet structure at the toe of the dam is a twin reinforced concrete box with a reinforced concrete headwall. The headwall structure is very seriously eroded, presumably by freeze and thaw action, and is in urgent need of replacement (Appendix C, Photo No. 8). The 24 in. dia. gate was open and the upstream 36 in. dia. gate was partially opened and closed again at the time of the inspection. The 36 in. dia. gate on the downstream side is open and unserviceable. It is not known whether the side takeoff pipe in which the venturi is installed is serviceable.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of the Pawtucket Reservoir (Arnold Mills) Dam took place on 27 September 1978. The main dam is judged to be in good condition, as is the East Dike, a smaller dam of similar construction. The concrete spillway shows considerable surface deterioration with indications of seepage at construction joints. Some of the 2 ft. high flashboards are missing. The concrete headwall at the downstream end of the outlet structure has almost disintegrated. There are many mature trees with thick brush growing on the western part of the dam. The embankment crest shows some localized areas of erosion, such as at the east abutment of the spillway.

b. Dam

The main dam embankment between the left abutment and the spillway shows no evidence of horizontal or vertical movement. There is some local erosion of the crest, particularly adjacent to the spillway abutment wall. The grouted riprap on the upstream face is in good condition. Seepage of the order of 2-3 gpm was noted at the left abutment near the toe of the downstream slope of the embankment, at a point 50 ft. to the left and 20 ft. downstream of the left edge of the headwall of the outlet pipe. There was another small seep of about ½ gpm immediately to the left of this headwall. According to Water Supply Board Staff, seepage has been previously observed from a point 84 ft. left of the gate house and 60 ft. downstream to a point 10 ft. left of the gate house and 80 ft. to 100 ft. downstream, near the concrete outlet structure. Brush had been cut recently and the stumps of several trees indicated that these have been removed during the past year or two.

The long earth dike between the spillway and the right abutment is heavily overgrown by mature trees, a few of which have been recently felled (Appendix C, Photo No. 1). The grouted riprap on the upstream slope is generally in good condition, with some minor spall areas noted (Appendix C, Photo No. 2). Nevertheless, these spalled areas have rock in the openings. Where the dike is less than about 6 ft. high, the slope protection is hand-placed cobblestone rock without grouting.

SECTION 2 - ENGINEERING DATA

2.1 Design

The dam appears to have been designed by the City of Pawtucket Public Works Department in 1925. Plans were obtained from the City Engineer (see Appendix B).

2.2 Construction

The dam was constructed by John J. McHale & Sons, Pawtucket, in 1926-27. The contract included: (1) the main dam; (2) the East Dike; (3) reconstruction of the N.Y., N.H. & H. Railroad line across the reservoir basin (now abandoned and accommodating a natural gas line); and (4) protection of the Diamond Hill Dam from the wash of the new reservoir.

2.3 Operation

The project is operated in conjunction with Diamond Hill reservoir immediately upstream as a single water storage facility by the Water Supply Board, Pawtucket. There are no formal operating procedures. The project has a resident caretaker. The levels of both reservoirs are lowered 8 ft. to 10 ft. every summer before the August - September hurricane season.

2.4 Evaluation

a. Availability

Insufficient engineering data is available from the design plans for an assessment to be made of the structural stability of the embankment.

b. Adequacy

The engineering data recovered and visual observations of the inspection team form the basis for the review and assessment of the adequacy of this dam. Insufficient data has been obtained for an evaluation of the safety of the embankment.

c. Validity

The validity of the engineering data acquired covering the dam and spillway structure is considered acceptable and is not challenged.

h. Spillway

1. Type - Concrete ogee w/2 ft. flashboards

2. Length of weir - 151 ft.

3. Crest elevation - 160 MSL

4. Gates - Flashboards are only spillway regulation devices

5. U/S Channel - None

6. D/S Channel - Natural, heavily wooded

7. General - N/A

i. Regulating Outlets

The only regulating outlets are the 24 in. and 36 in. dia. manual gate valves described in b.l. above and shown on the plans in Appendix B. The 24 in. gate is used for normal flows, while the 36 in. gate is used to lower the reservoir and during flood events.

e. Storage (acre-feet)

1. Recreation pool - N/A

2. Flood control pool - N/A

3. Design surcharge - 5,125

4. Top of dam - 5,300

f. Reservoir Surface (acres)

1. Top dam - 282

2. Maximum pool - 276

3. Flood-control pool - N/A

4. Recreation pool - N/A

5. Spillway crest - 255

g. Dam

1. Type - Earthen w/grouted riprap upstream face

2. Length - 2,900 ft.

3. Height - 32.5 ft.

4. Top Width - 18 ft.

5. Side Slopes - 2 to 1 with 6 ft. berms at 19 ft. level

6. Zoning - Clay backfill in core trench and surrounding core wall

7. Impervious Core - Concrete core wall to elevation 165.00

8. Cutoff - Some wood sheet piling

9. Grout curtain - Unknown

10. Other - N/A

2. No records of flood events at the Pawtucket Reservoir damsite were recovered. According to the resident caretaker for the past 35 years, the spillway and outlet conduit in combination were adequate for any flood event during his tenure. There has been no major flood event since the recent raising of Diamond Hill Dam upstream, with construction of a new spillway.

3. The spillway at Pawtucket Reservoir Dam consists of a massive cyclopean concrete ogee weir with flashboards extending 2 ft. above the spillway crest. With the flashboards removed it is estimated that the spillway capacity is about 6,700 cfs at maximum pool elevation 165.5.

c. Elevation (ft. above MSL)

1. Top Dam - 166.5

2. Maximum pool-design surcharge - 165.5

3. Full flood control pool - N/A

4. Recreation pool - N/A

5. Spillway crest (gated) - 162.0 (with flashboards in place)

6. Upstream portal invert diversion tunnel - N/A

7. Streambed at centerline of dam - 134

8. Maximum tailwater - unknown

d. Reservoir

1. Length of maximum pool - 6,500 ft.

2. Length of recreation pool - N/A

3. Length of flood control pool - N/A

Flashboards as much as 2 ft. high are generally mounted atop the Pawtucket Dam spillway crest, for the purpose of occasionally capturing and withholding surcharge storage above spillway crest level and thereby increasing the yield of the reservoir. Approximately 500 acre-ft. of storage space is contained within the 2 ft. surcharge encroachment. This leaves only about 900 acre-ft. to the level of the top of the dike remaining for routing high magnitude floods, if such were to occur when the reservoir was full to the top of the flashboards at the start of the flood event.

b. Discharge at Damsite

1. An outlet conduit has been carried through the dam at a point about 400 ft. to the right of the left abutment of the dam, such that discharges will empty directly into the original riverbed. The conduit is constructed of precast concrete pipe, being 48 in. dia. upstream from the crest of the dam and 60 in. dia. downstream. Regulation of flows through the outlet is by means of gate valves installed in a gate house and shaft located near the crest of the dam. The piping at the floor of the shaft consists of a 36 in. dia. cast iron pipe cross, with three 36 in. gate valves installed on three sides of the cross piece. Two of the valves are placed in line with and connected to the outlet pipes, to provide an upstream closure valve and a downstream regulating valve for reservoir releases. The 36 in. side valve connects to a 36 in. cast iron pipe bedded on a concrete cradle, which parallels the downstream leg of the conduit and reenters the main outlet near its lower end. A venturi meter is installed along the 36 in. pipe to measure outflows. Access to the venturi chamber is by means of a brick manhole located on the berm at the downstream slope of the dam.

   A 24 in. C.I. pipe high level intake, with centerline at elevation 147.35, connects to the fourth side of the cross piece. Flow through this intake pipe is regulated by a 24 in. gate valve placed in the line at elevation 147.35 just upstream from the elbow and vertical line which leads to the crosspiece inlet. All reservoir releases are made through the outlet structure, discharging directly to the downstream river.

1.3 Pertinent Data

a. Drainage areas

Arnold Mills reservoir is the lower of two impoundments on Abott Run, situated in a valley formed by the junction of several small streams draining the area to the west and north. Diamond Hill reservoir, which occupies the area to the north of the Arnold Mills lake, receives its inflow from Burnt Swamp Brook. Arnold Mills reservoir captures runoff from the area to the west, from Miscoe Lake and Catamint Brook, Ash Swamp Brook, East Sneech Brook, and Long Brook. The area above Miscoe Lake drains land in the State of Massachusetts; the remaining drainage area lies in the State of Rhode Island.

The drainage area above Diamond Hill Dam is about 8.42 square miles, of which about 0.6 square miles is occupied by the reservoir. The topography of the Diamond Hill drainage area is generally wooded rolling hills terrain, except that about 0.75 square miles of the stream valley is occupied by a low lying swamp. The length of the water course upstream from the Diamond Hill reservoir is about 5 miles, with an average slope of 40 ft. per mile.

The drainage area above Arnold Mills reservoir and below Diamond Hill Dam measures roughly 5 miles by 2 miles and is about 9 square miles in extent, of which the reservoir occupies 0.4 square miles. The topography of the area is generally wooded rolling hill to mountainous, with occasional small perched swampy areas at the stream head-waters and along the streams courses. The rim of the basin rises to an average of about 220 ft. above the valley, with individual hills rising to as much as 385 ft. above the valley level. The longest water course upstream from the Arnold Mills reservoir measures about 4.4 miles, with an average slope of 52 ft. per mile.

Arnold Mills reservoir is about ½ mile in length and 1.3 miles in breadth, with a surface area at normal storage level of 270 acres. The reservoir impounds about 3,600 acre-ft. to spillway crest level elevation 160, 5,000 acre-ft. to top of dike level 165.5 and 5,300 acre-ft. to top of main dam level 166.5. Reservoir area-capacity curves are shown on Plate 1 in Appendix D.

The Diamond Hill reservoir impounds 11,000 acre-ft. to spill-way crest elevation 198. An additional surcharge storage space of 4,680 ac.-ft. is available from spillway crest level to the top of the dam.

f. Operator

Mr. Robert P. Blauvelt, P. E.
Chief Engineer
Water Supply Board
Public Works Center
250 Armistice Boulevard
Pawtucket, Rhode Island 02860

Telephone: (401) 728-0500

g. Purpose of Dam

The dam impounds a reservoir used for the City of Pawtucket's municipal water supply.

h. Design & Construction History

From the drawings recovered from the files of the Water Supply Board and City Engineer, it appears that the dam was designed by the City's Public Works Department in 1925. Construction of the Arnold Mills reservoir project began that year with reinforcement of the Diamond Hill embankment by means of a heavy earth fill and stone revetment. About 60 percent of the work on the main dam and dikes was accomplished in 1926 and the project was substantially completed by the end of 1927 at a total cost of $812,500. The contractor was John J. McHale & Sons of Pawtucket. Storage of water commenced in the spring of 1927 and the reservoir was filled for the first time on 17 February 1928. On 30 April 1928 flashboards 12 in. high were set on the spillway to increase the storage capacity.

i. Normal Operational Procedure

There are no formal operational procedures. According to the Chief Engineer, Water Supply Board, both the Arnold Mills and Diamond Hill reservoir levels are customarily lowered 8 ft. to 10 ft. before the August - September hurricane season to provide additional surcharge storage. The Chief Engineer also said that, since the recent raising of the Diamond Hill dam upstream, the Arnold Mills reservoir level is usually maintained below spillway level and the additional storage from flashboards is no longer required.

According to the caretaker of Diamond Hill and Arnold Mills reservoirs for the past 35 years, the Pawtucket Dam spillway has accommodated all flood events during that period. He says that he opens the 36 in. dia. gate when there is 6 in. depth of water over the spillway.

The spillway outlet channel beyond the stilling basin is excavated to about downstream river level and is unpaved. The channel, for about 100 ft. downstream from the stilling basin, is excavated in bedrock while the rest is in earth. Concrete gravity guide walls are provided on each side of the channel. The right guide wall varies from 10 ft. high at the stilling basin to about 2.5 ft. high at about 310 ft. downstream. The left guide wall varies from a 10 ft. height at the basin to a 4 ft. height at about 150 ft. downstream.

The spillway concrete is generally of massive construction, and with the exception of some reinforcement in the sill block at the stilling basin, is unreinforced. The overflow dam is shown to be of cyclopean concrete. Flashboards have been installed on the spillway crest for the purpose of capturing additional storage and increasing the water yield of the project. Holes were drilled into the crest and steel pipe standards were installed to which 24 in. high flashboards were bolted. The size of the pipe standard was so selected that it was expected to bend over when the head reached a certain level over the top of the boards, and thereby increase the spillway capacity.

c. Size Classification

The height of Pawtucket Reservoir Dam is 32.5 ft. and the storage capacity of the reservoir is about 5,125 acre-ft. at maximum pool elevation 165.5. While the height of the dam suggests it may be placed in a small size category, the storage capacity is of sufficient size to warrant a size classification of intermediate as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

Arnold Mills Reservoir is located immediately upstream of several extensive residential developments, several local roads, Interstate Route 295, and assorted commercial establishments. Accordingly, the Pawtucket Reservoir Dam is classified as high hazard in accordance with the above referenced guidelines.

e. Ownership

The dam and reservoir are owned by the City of Pawtucket.

ledge rock formation, noted on the drawing as "hard red rock". For the remaining length of dam beyond the left 1,500 ft. length, the core trench did not reach bedrock, but was carried only to about the level of the reservoir floor. The concrete core wall is 12 in. thick at its top and 24 in. thick at the base, sitting on a 6 to 7 ft. wide footing slab at the bottom of the core trench. Along portions of the wall length where the footing trench did not reach bedrock and where the sand foundation appeared particularly pervious, a line of wooden sheet tongue and groove piling was driven to depths of about 8 ft. below the bottom of trench level.

3. East Dike

The East Dike is located about 1000 ft. to the right of the main Pawtucket Dam, to close off a saddle area leading to a small tributary which flows into Abbott Run about 1 mile below the dam. The cross section of the dike is similar to that of the main dam, except that for the center 241 ft. of its length the top of the dike is at elevation 165.5, or 1 ft. lower than its abutments or the main dam. The foundation at the dike, except for short lengths where bedrock was encountered, is coarse sand and gravel. The core trench was carried only to about the level of the bottom of the reservoir, and the concrete core wall was extended from the bottom of the trench to within 2 ft. of the top of the dike.

4. Spillway

The spillway is located on the right abutment of the dam, about 300 ft. to the right of the main river channel. The crest of the spillway has a length of about 151 ft. at elevation 160.0, or 6.5 ft. below the top of the dam. The overflow is about a 30 ft. high gravity cyclopean concrete ogee section presumably founded on bedrock. The gravity section has a width of about 5 ft. at its top and 27 ft. at its base, with ¼ to 1 and ½ to 1 slopes for its upstream and downstream faces, respectively. The overflow empties into a 20 ft. long stilling basin whose floor is about 24 ft. below crest level. A wide concrete sill, with top 5 ft. above the basin floor, is provided at the end of the stilling basin. Concrete gravity side walls retain the earth embankment adjacent to the spillway.

about 6 miles north of Pawtucket, 1300 ft. north of the junction of North Attleboro and Sneech Pond Roads. The project is operated in conjunction with Diamond Hill reservoir immediately upstream to the north of Arnold Mills reservoir as a single water supply storage facility.

b. Description of Dam & Appurtenances

1. General

Drawings showing the reservoir layout, plan and sections of the dam and appurtenant structures, and foundation boring and test pit data, prepared by the City of Pawtucket in 1925 and 1927, are available and are included in Appendix B (Dwgs D1-F2-5 and 6, D1-F2-9 thru 16, and D1-F2-19). A sketch showing profiles along the crest of dam and cross sections of the dam and dike are delineated on Plate 2 in Appendix D.

2. Main Dam

The main dam is a zoned earthfill embankment about 2,900 ft.long with a maximum height of about 33 ft. The dam has a crest width of 18 ft., and 2 to 1 slopes on both upstream and downstream faces. Where the height exceeds 19 ft., berms are provided at the 19 ft. level; the width of the upstream berm varies while the downstream berm is 6 ft. wide. Below the downstream berm, the dam slope continues on 3 to 1 for about 8 ft. and then flattens onto a wide sand and gravel bench placed in the original river bed section. The dam zoning consists of a concrete core wall constructed from the bottom of a core trench to within 2 ft. of the top of the dam, a clay backfill in the excavated core trench and surrounding the concrete core wall, and a gravel and loam filled outer shell. The upstream face of the dam is paved with a laid-up riprap which was surface flushed with cement mortar. Two continuous horizontal concrete walls are carried along the upstream slope flush with the top of the riprap to act as "paving stops" to hold the riprap in place. One wall is approximately at normal water surface and one wall is at the toe of the slope.

The foundation of the dam for the most part is a sandy material with some lenses of gravel. For about the 1,500 ft.left portion length of the dam, the core trench was excavated through this pervious foundation to a

PHASE I INSPECTION REPORT

PAWTUCKET RESERVOIR DAM RI 00803

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers nas been assigned the responsibility of supervising the inspection of dams within the New England Region. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Rhode Island. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 24 August 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0371 has been assigned by the Corps of Engineers for this work.

b. Purpose

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

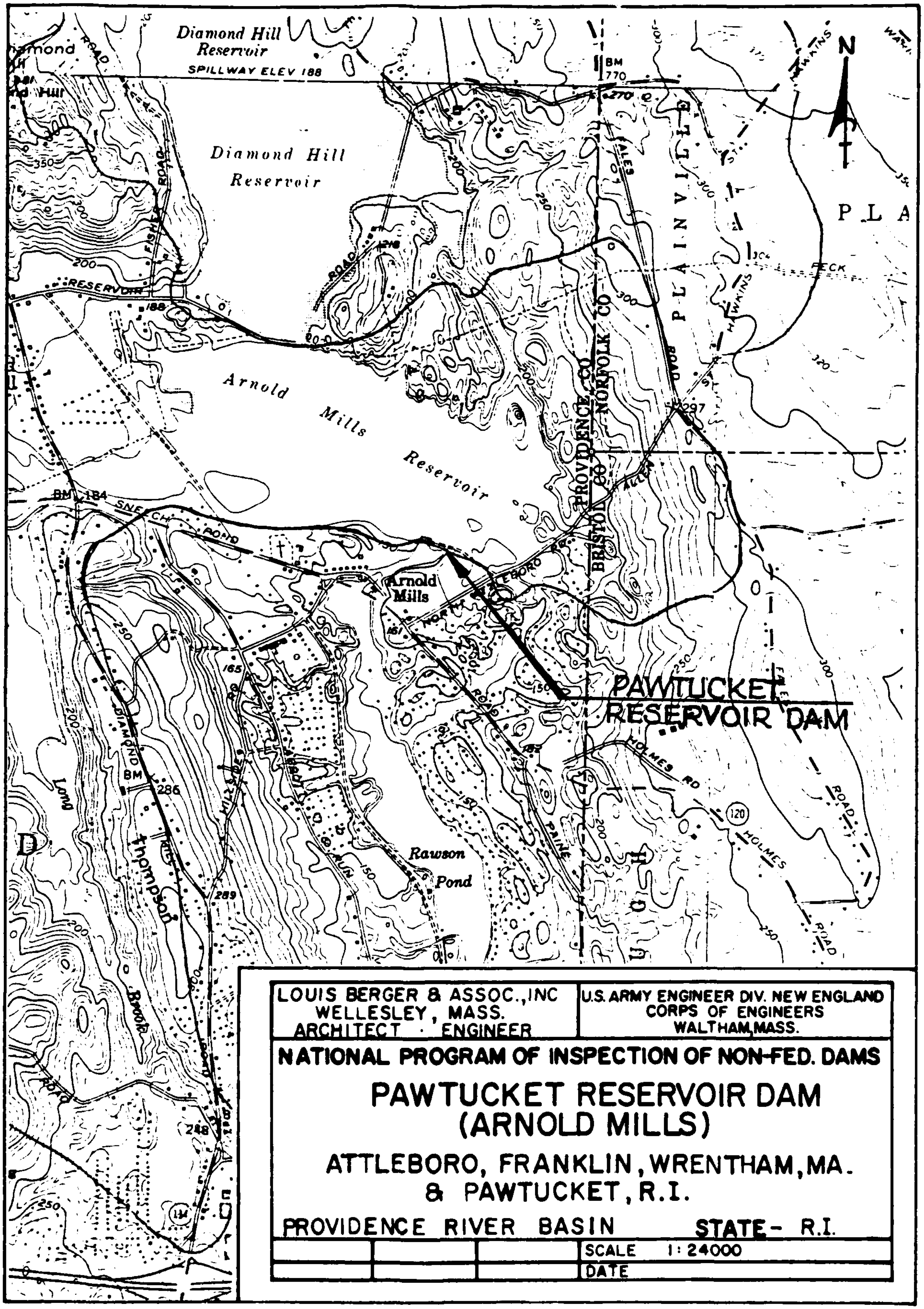
2. Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Pawtucket Reservoir Dam, which impounds Arnold Mills reservoir, is a municipal water supply facility for the City of Pawtucket, Providence County, Rhode Island. The reservoir is located on the Abbott Run River about 7.5 miles upstream from its confluence with the Blackstone River, a tributary of the Providence River. It is situated to the east of Diamond Hill Road (State Highway 114)



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PAWTUCKET RESERVOIR DAM (ARNOLD MILLS)

ATTLEBORO, FRANKLIN, WRENTHAM, MA. & PAWTUCKET, R.I.

PROVIDENCE RIVER BASIN — STATE - R.I.

SCALE 1:24000

DATE

d. Reservoir Area

An inspection of the reservoir shoreline revealed no evidence of ground instability. The left shoreline includes the East Dike along North Attleboro Road. The horizontal and vertical alignment of the dike appear to be good and the grouted cobblestone riprap on the upstream slope is in generally good condition with a few areas of minor erosion (Appendix C, Photo No. 9). The crest of the dike has mature tree growth and there are a few areas of brush on the downstream slope near the left abutment (Appendix C, Photo No. 10) which should be removed. At the time of the inspection, no seepage could be seen, but the reservoir level was at approximately the toe of the upstream slope.

e. Downstream Channel

The spillway outlet channel is at about the same elevation as the downstream river. The concrete guide walls are of differing lengths, the right being about 310 ft. long and the left 150 ft. long. The channel is generally overgrown with brush. About 1,000 ft. downstream, there is a small old dam of little significance, and both the old and new Sneech Pond Road bridges span the river.

3.2 Evaluation

The visual inspection of the dam, together with available engineering data and historical information from the owner, permitted a reasonably satisfactory assessment to be made of those features relating to the performance of the structure. The dam is considered to be in good condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The City of Pawtucket, Water Supply Board, operates the Pawtucket Reservoir and Diamond Hill dams jointly. The Arnold Mills and Diamond Hill reservoirs supply water to the city's municipal system. There appear to be no formal operating procedures. The reservoir levels are said to be lowered 8 ft. to 10 ft. each year before the August - September hurricane season. The 36 in. dia. outlet gate is said to be opened if more than a 6 in. depth of water passes over the spillway during a storm event.

4.2 Maintenance of Dam

Maintenance is carried out as required by city personnel. Brush and tree cutting is performed when funds and personnel are available.

4.3 Maintenance of Operating Facilities

The only operating facilities are the manually operated gate valves, with screw lift hoists. With one exception, they appear to be in good condition, periodically inspected and operated at regular intervals. The downstream 36 in. gate is inoperable and requires repair. The gate house is secure, but has some superficial damage due to freeze-thaw cycles.

4.4 Warning System

There is no formal warning system or program at this dam. The resident caretaker reports to Water Board staff by telephone and has many years of experience, including several storm events. Prompt response to an emergency situation may thus be reasonably expected, but a formal program should be developed, with sequences and responsibilities defined and personnel trained in its implementation.

4.5 Evaluation

Operational procedures should be formalized and put into writing. The level of effort put into routine maintenance requires increasing. Operating facilities should be put into good repair where necessary and a flood warning plan should be developed and implemented.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

1. Discharge Capacities

A spillway discharge curve for the Pawtucket Dam, assuming a crest at elevation 160 and flashboards removed, is shown in Appendix D on Plate 3 (page D-10). Also shown are discharges over the dam and dike in the event of an overtopping of the structures, assuming that failure would not result by such overflows. Outlet capacities, with 36 in. gate valves wide open, are shown on Plate 4 (page D-13). Shown on Plate 5 (page D-15) is the spillway discharge curve for Diamond Hill Dam spillway, for use in routing flood inflows above Diamond Hill reservoir into the Arnold Mills reservoir.

2. Flood for Testing Dam Adequacy

The test flood chosen to evaluate the hydrologic and hydraulic capacity of Pawtucket Reservoir Dam and Arnold Mills Reservoir was selected in accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams. Since this dam is classified as intermediate in size with a high hazard potential, a test flood of a magnitude corresponding to the Probable Maximum Flood was selected for the evaluation.

3. Flood Hydrology

For the purpose of flood routings to determine resulting maximum surcharges in the reservoirs and corresponding outflows into the downstream valley, PMP inflow hydrographs were developed by hydrometeorological methods utilizing the Corps of Engineers HEC-1 program. Separate hydrographs were prepared for the sub-drainage area above Diamond Hill Dam and for the sub-area below Diamond Hill and upstream from Pawtucket Dam. The inflows above Diamond Hill were routed through the Diamond Hill reservoir and spillway to provide the inflow into Pawtucket reservoir from that sub-basin, which were then added to the inflow hydrograph for the lower sub-basin to form the combined hydrograph for testing the Arnold Mills reservoir and Pawtucket dam spillway adequacy.

The Probable Maximum Precipitation values for this area were obtained from Hydrometeorological Report No. 33 and adjusted for basin size, basin shape factor, and storm duration in accordance with standards presented in the Design of Small Dams. Rainfall during the first six hours of the test storm of 19.4 in. was distributed and rearranged according to guidelines suggested by the Corps of Engineers. Storm runoff concentration time was estimated utilizing an average flow velocity from the farthest portions of the drainage area. The lag time used for the Arnold Mills Reservoir basin was 2.56 hours, from which a synthetic curvilinear unitgraph was developed. Calculations are given in Appendix D (pages D-2 thru D-7). The results of the HEC-1 computer program, including the flood routings, are presented on the printouts in Appendix D (pages D-21 thru D-57).

As indicated on the printouts, for a PMP storm the resulting hydrograph peak inflow into the Diamond Hill reservoir was about 17,700 cfs., or a CSM value of about 2,100 cfs. This value agrees closely with the Corps of Engineers NED envelope curve value for mountainous terrain. For the Arnold Mills drainage basin, the resulting hydrograph peak was about 20,400 cfs. or a CSM value of about 2,270 cfs. By comparison the NED envelope curve for mountainous terrain shows a CSM value of about 2,000 cfs.

Routing the PMF through the Diamond Hill reservoir and spillway results in a maximum outflow of about 9,500 cfs. at surcharge elevation 208.5 or to a maximum reservoir level of about 1.5 ft. below the crest of the dam. This peak outflow would occur at about 9 hours after the start of the flood event. The inflow of 20,400 cfs. from the Arnold Mills basin would peak at 6½ hours after the start of the flood event. Combining the Diamond Hill reservoir outflow hydrograph and the Arnold Mills basin hydrograph results in a peak inflow of 25,800 cfs. occurring at about the 7th hour after the start of the flood event. This discharge is equivalent to a CSM of 1,480 cfs. for the 17.5 sq. mi. drainage area. The CSM values shown on the NED envelope curves for a 17.5 sq. mi. area are 2,100 cfs. for mountainous terrain and 1,500 cfs. for rolling terrain.

For ½ PMF and lesser magnitude hydrographs, discharges and volumes were taken as direct ratios of the PMF hydrograph.

b. Experience Data

Construction of the raised Diamond Hill Dam immediately upstream was completed in 1972, since when there has been no flood event of historic magnitude. No records were recovered for earlier events. According to the resident caretaker for the past 35 years, the 36 in. dia. gate has been opened whenever the depth of water over the spillway reaches 6 in.

c. Visual Observations

1. General

The 50-year old concrete spillway shows some surface deterioration but appears serviceable. The outlet gate valves are operable, with the exception of the downstream 36 in. dia. valve, which is in the open position. Part of the spillway flashboards and some of their supports are missing.

2. Upstream Damage Potential

Diamond Hill reservoir and dam lie directly to the north of Arnold Mills reservoir, such that when full to normal storage level the lower reservoir forms the tailwater for the Diamond Hill Dam spillway. As noted above, a PMP flood can be handled by reservoir surcharge and spillway capacity without threatening an overtopping of the Diamond Hill Dam. The dam is of recent design and construction and its structural soundness should therefore be good. Thus, the upstream dam and reservoir are considered to pose no threat to the inundation of the Arnold Mills reservoir.

The 1975 USGS quadrangle confirms visual checks that no homes or improvements would be threatened if the Arnold Mills reservoir rose to the crest of Pawtucket Dam. Except for the Highway 114 bridge across Sneech Brook at the upper end of the reservoir, no major roads would be affected by a rise in the reservoir to top of dam level.

d. Overtopping Potential

Routing the PMP flood developed above and utilizing the surcharge and discharge values shown on Plates 1 and 3 results in a total peak outflow through the Pawtucket Dam spillway and over the main dam and East Dike of about

25,750 cfs. at surcharge elevation 167.65 (see computer printout flood routing on Plate 6, page D-17). The East Dike would be overtopped 2.15 ft. with a maximum outflow of about 4,000 cfs. The duration of overtopping would be about 10 hours and a total outflow of about 1,750 acre-ft. would be spilled over the Dike. The maximum unit discharge over the dike would be about 9 cfs. per ft. The main dam would be overtopped 1.15 ft. with a maximum outflow of about 10,500 cfs., or a unit discharge of about 3.5 cfs. per ft. of length.

Routing the 0.5 PMP flood results in a peak outflow through the spillway and over the main dam and East Dike of about 11,500 cfs. at elevation 166.74 (see computer printout flood routing on Plate 7, page D-18). The Dike would be overtopped 1.24 ft. with a maximum outflow of about 1,400 cfs. The duration of overtopping would be about 5 hours and a total outflow of about 380 acre-ft. would be spilled over the Dike. The maximum unit discharge over the Dike would be about 4 cfs. per ft. The main dam would be overtopped 0.24 ft. with a maximum outflow of about 950 cfs., or a unit discharge of about 0.3 cfs. per ft. of length.

Routing a 0.4 PMP flood results in a peak outflow of 6,750 cfs. at reservoir elevation 165.5, all released through the spillway. Except for splashing by wave action over the Dike and dam, no overtopping of the main dam and Dike would occur. It may be noted that the outflow of about 170 cfs. through the outlet is negligible in relation to total test flood outflows.

e. Drawdown Capacity

Reservoir drawdown is provided by a 48 in. pipe controlled by 36 in. gate valves at invert elevation 128.5. Utilizing only this outlet, it would require about 19 days to lower the reservoir level from spillway crest elevation 160 to the entrance invert of 128.5. The drawdown calculations assume no inflow to the reservoir during the drawdown operation. The time required for any indicated interval of drawdown requires adjustment consistent with reservoir inflow, if any, during the dewatering operation.

f. Downstream Hazard Potential

A breach of either the main dam or the East Dike could conceivably occur either from overtopping or from structural failure. Assuming that the reservoir level is at the top of the main dam, the "rule of thumb" criteria suggested in the NED March 1978 Guidance Report would be applicable. For a 100 ft. wide sudden breach failure washing out to the base of the main dam, a release up to 15,000 cfs. would empty into the downstream valley and Rawson Pond. Combined with a spillway discharge of 8,400 cfs., the total discharge would be about 23,400 cfs. If the reservoir level is assumed to be at spillway crest level when structural failure of the main dam occurs, a release of 9,800 cfs. into the valley is possible.

At the East Dike, failure with the reservoir level at the top of the Dike could discharge up to 5,300 cfs. into the tributary stream which joins Abbott Run and flows into Rawson Pond. At this reservoir level, the spillway discharge would be 6,800 cfs., giving a total flow below the confluence of the tributary of 12,100 cfs. into Rawson Pond. Failure of the Dike with the reservoir assumed to be at spillway level would release about 2,500 cfs. into the tributary stream.

As noted in Section 1, the banks of the tributary stream and ponds leading from the East Dike saddle to Abbott Run are heavily dotted with homes which could be threatened by flooding from a discharge of 2,500 to 5,300 cfs. due to sudden failure of the East Dike. Below its confluence with the tributary, on the main stream along Rawson Pond, many homes along the east shore are close to the level of the pond and would be subject to inundation owing to a large rise in the pond level. Failure of the East Dike could cause a discharge between 2,500 and 12,100 cfs. into the main stream, while failure of the main dam could result in a discharge of 9,800 to 23,400 cfs.

The restriction at Rawson Pond Dam forms a control to cause a backwater into the upstream valley. Plate 8, page D-19, shows estimated stage-discharge curves at the Rawson Dam, both for flows over the dam if it remains in place and for flows if the dam washes out. Tabulated in Table 1 are upstream valley storage amounts above the level of Rawson Pond, elevation 116.

Table 1

Valley Storage Above Rawson Pond Dam

Elevation	Area Acres	Valley Storage Acre-Feet
116	32	0
120	67	198
125	90	580
130	110	1083

Considering an outflow from Pawtucket Dam for the 0.5 PMP flood event, even if a breaching at the dam did not occur, a discharge of about 11,500 cfs. (Plate 7, page D-18) would still prevail to show a stage at about elevation 124 (Plate 8, page D-19). Upstream valley storage for this stage would be about 500 acre-ft., which would fill in about ½ hour at a sustained 11,000 cfs. flow. At this stage at Rawson Pond, a count on the 1975 USGS quadrangle map shows about 20 homes below the elevation 124 level. Failure of the East Dike with a discharge of up to 12,100 cfs. could be expected to affect these same homes.

Failure of the main dam could result in a discharge between 9,800 and 23,400 cfs. From Plate 8, page D-19 , a stage at about elevation 123 would prevail for 9,800 cfs. From the table on page D-20, a discharge of 23,400 cfs. corresponds with a stage of about 130, with at least 15 additional homes being affected in the Rawson Pond area.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The field investigations of the earth embankment and dike revealed no significant displacements or distress which would warrant the preparation of slope stability computations based on assumed soil properties and engineering factors.

b. Design and Construction Data

No plans or calculations of value to a stability assessment are available for this dam.

c. Operating Records

No pertinent operating records appear to exist for this dam.

d. Post Construction Changes

The results of the field inspection and a check of the available records produced no evidence of changes which might influence stability.

e. Seismic Stability

The dam is located in Seismic Zone No. 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analyses.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

1. General

On the basis of the Phase I visual examination, the dam appears to be in good condition and functioning adequately. The deficiencies revealed tend to indicate that additional effort should be applied to routine maintenance. The spillway has only sufficient capacity to accommodate about 40% of the full PMF (which was selected as the appropriate test flood) without overtopping the main dam and East Dike.

2. Main Dam and East Dike

The freeboard height from normal reservoir elevation 160 to the top of the main dam is 6.5 ft., and to the top of the East Dike it is 5.5 ft. If 2 ft. high flashboards are placed on the spillway crest, this freeboard may be reduced by up to that amount. With a reservoir fetch of over one mile, during a storm wave action of up to 3 ft. could ride up the slopes of the dam and Dike to threaten an overtopping. With added freeboard encroachment needed to provide head for even small discharges over the flashboards, an overtopping of the Dike becomes a distinct possibility.

Because the crest of the East Dike is one foot lower than the top of the dam, it would be subjected to overtopping from much smaller magnitude floods than would overtop the main dam. Since the area of greater hazard from an overtopping is located below the Dike, it would appear prudent to safeguard this area by raising the Dike to a level at least equal to or preferably higher than the main dam.

3. Spillway

The spillway crest structure and retaining walls are constructed mainly of mass concrete and there are no visible indications of structural inadequacy regarding stability or movement. The concrete surfaces show some deterioration, either owing to freeze and thaw action

or from seeps through construction joints because of poor workmanship during construction. The condition of the concrete does not now threaten the stability of the structure. To preserve the concrete from serious deterioration, a maintenance program to repair damaged areas could be instituted.

The stilling basin apron is now strewn with rocks and debris, which should be removed. This material is trapped in the stilling basin and during spillway flow could churn and abrade the concrete floor and end sill surfaces.

The use of flashboards on the spillway crest encroaches on surcharge capacity and freeboard, thus reducing the ability of the spillway and reservoir to handle increasingly larger inflows before an overtopping of the dam is threatened.

It is understood that the size of the pipe standards for flashboard supports was selected such that they would bend over when a certain design head over the flashboards was exceeded. It has been the experience at other installations that these pipe standards did not always fail at the specified head over the boards; sometimes they failed earlier and at other times they did not fail at heads far in excess of those contemplated. Further, when the boards did bend over but were not washed away, floating debris would catch and cling to the boards to partially clog the spillway opening. Most serious, in the event that a sudden failure of the boards did occur, is the large surge of outflow which can far exceed the inflow. Such a sudden failure will cause a flood wave downstream, generally with but little warning.

Removal of the flashboards in advance of a flood inflow cannot always be guaranteed, both because the runoff time is short and because access to and removal of the boards is difficult.

City Water Board personnel indicated that until Diamond Hill reservoir was enlarged in 1972, salvaging the added storage and yield at the Arnold Mills reservoir was important to their water supply needs. However, with the advent of the increased storage at Diamond Hill and with an operating program which would utilize the Arnold Mills storage ahead of Diamond Hill's, it was indicated that the additional storage capacity afforded by the flashboards was now not as important a consideration as previously.

On the basis of the above, the abandonment of the use of flashboards on the spillway crest should be considered.

4. Outlet Works

The outlet discharges are controlled from a shaft, situated near the crest of the dam, in which closure and operating valves are located. High and low level intake pipes lead to a 36 in. dia. C.I. cross piece in the shaft, from which two outlet pipes lead to an exit structure at the toe of the dam. Outlet releases are regulated by two 36 in. gate valves, which are installed on the upstream and downstream ends of the cross piece. It is understood that the downstream valve is stuck in the open position but the upstream valve is operable. The concrete outlet structure headwall is in a state of complete disintegration and should be replaced.

b. Adequacy of Information

The information recovered is considered adequate for the purpose of making an assessment of the performance of the dam.

c. Urgency

The dam appears to be in no immediate danger of becoming a hazard to life and property. The recommendations and remedial measures enumerated below should be implemented by the owner within two years after receipt of the Phase I Inspection Report.

d. Need for Additional Investigation

Additional investigations are required as recommended in Para. 7.2.

7.2 Recommendations

It is recommended that the owner should retain the services of a registered professional engineer with suitable experience to make investigations, studies, and if proved necessary, design remedial works for the following:

a. East Dike

To forestall an overtopping of the East Dike and thereby protect residences in the tributary draw below the Dike, the embankment should be raised.

b. Spillway

To guarantee the intended freeboard offered by the original design, use of flashboards on the spillway crest should be abandoned, and normal storage no higher than to elevation 160 should be allowed.

If it is deemed desirable to provide more spillway capacity to accommodate higher magnitude floods, this could be accomplished by lowering the spillway crest and installing radial or flap gates with top at present normal storage level elevation 160. If it is deemed advisable to provide more freeboard and surcharge storage, the spillway crest could be lowered without utilizing gates.

The engineering aspects of the deteriorated concrete in the spillway structure and walls should be studied and the extent of repairs required should be determined.

7.3 Remedial Measures

Existing deficiencies should be corrected by the owner as soon as possible. The principal requirements are:

1. Remove all brush and trees from upstream slope and crest of main dam and East Dike. It would be preferable to also remove all brush and trees from the downstream slopes.
2. Repair erosion gullies of crest and downstream slope on each side of the spillway.
3. Replace displaced riprap protection on upstream embankments.

4. Repair inoperable 36 in. gate valve.

5. Replace deteriorated concrete headwall at outlet.

6. Monitor condition of spillway structure concrete.

7. Monitor wet area and seepage along toe of downstream slope at left abutment of main dam periodically during periods of high reservoir level and not less than once each year.

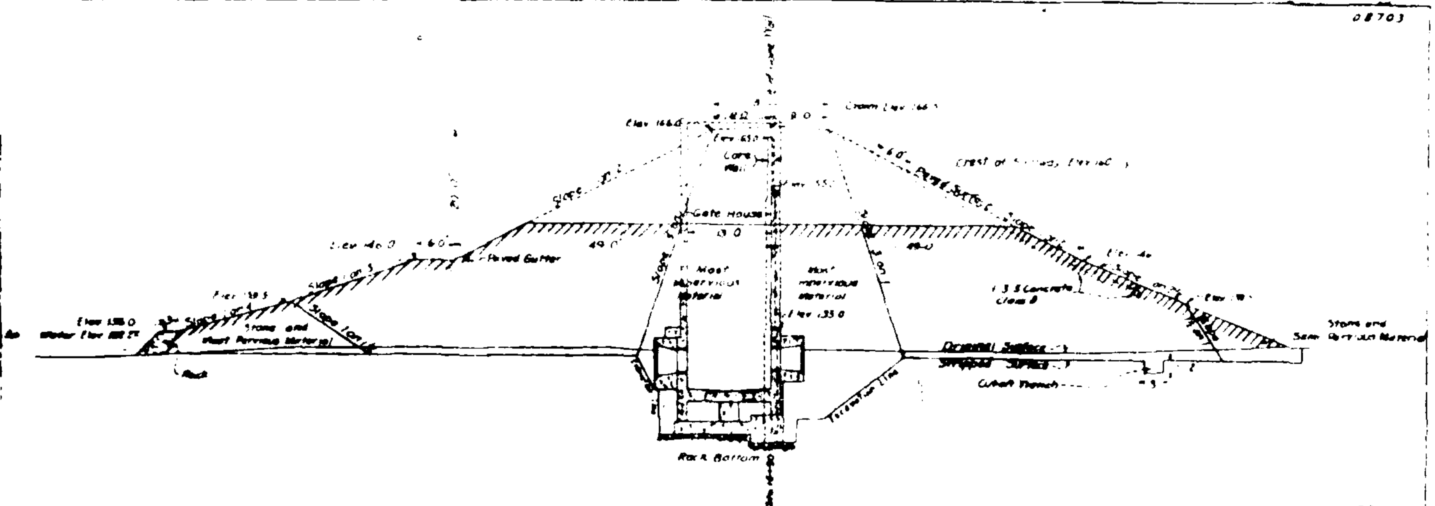
8. Develop a formal surveillance and flood warning plan.

a. Operation & Maintenance Procedures

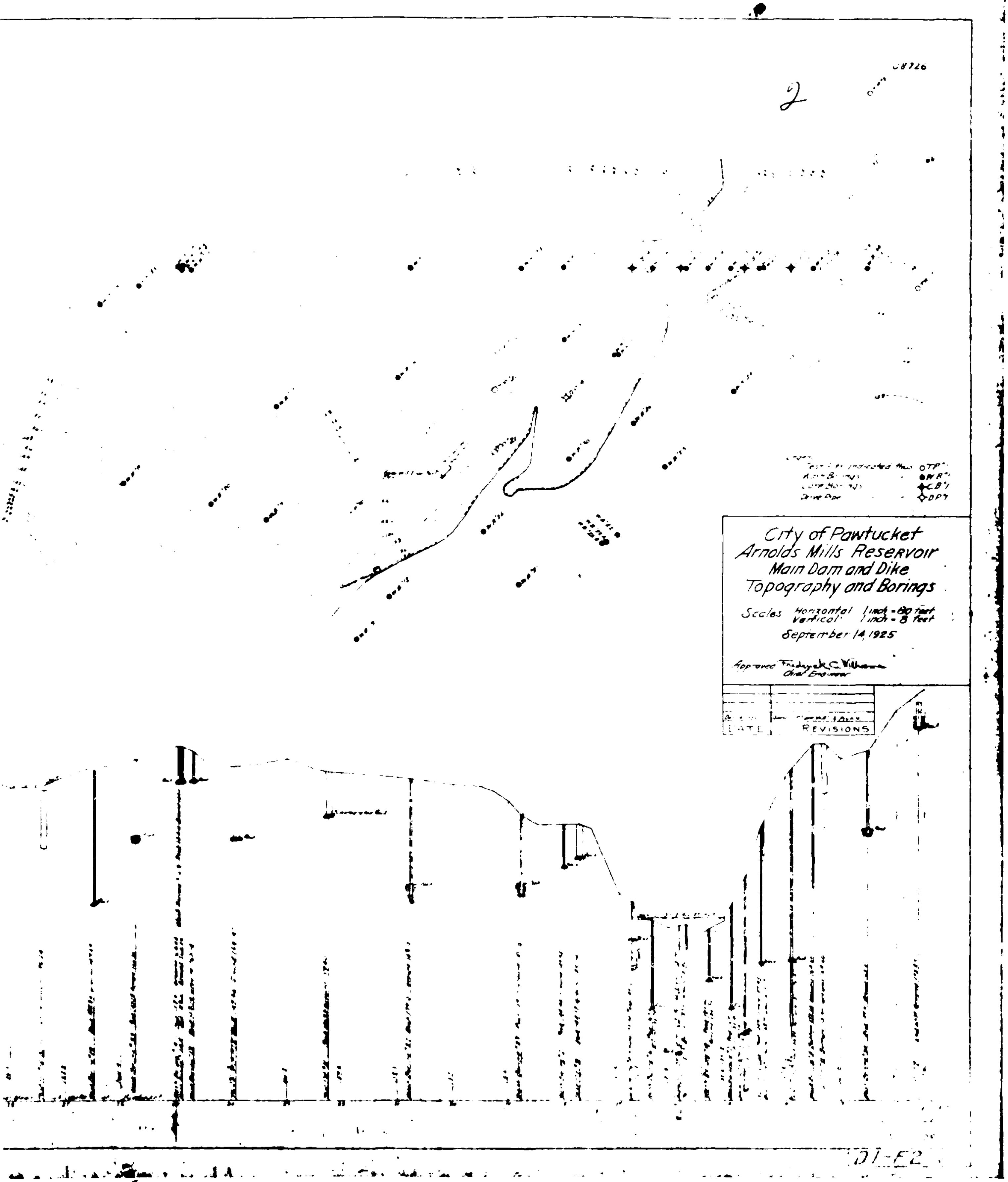
The owner should institute procedures for a biennial periodic technical inspection of the dam and appurtenant works, with supplementary inspections of any suspect items. A check list for periodic inspections should be developed and records should be kept of all maintenance and repair work performed. Ordinary maintenance, such as cutting brush, should be carried out in accordance with a regular and consistent program.

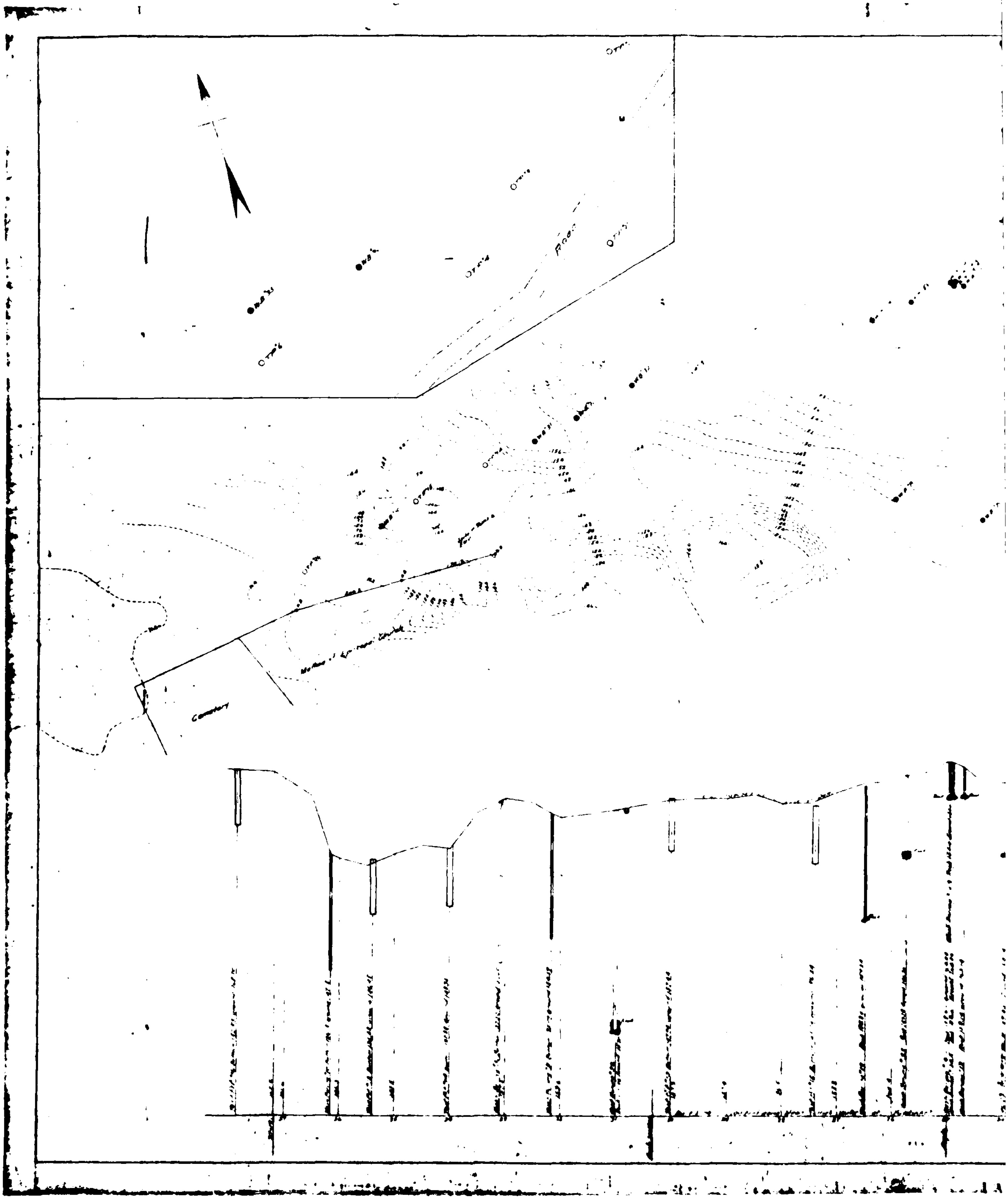
7.4 Alternatives

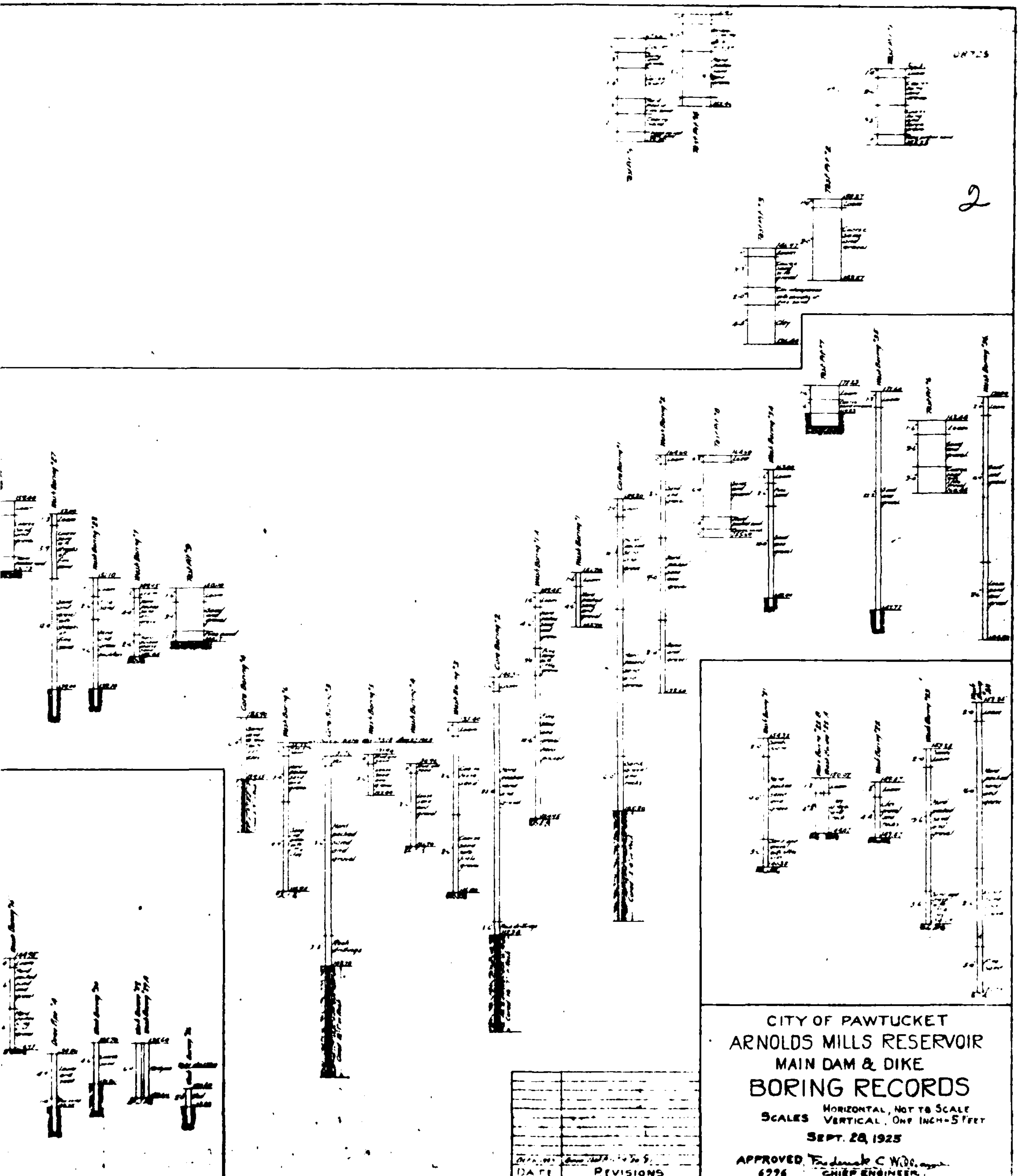
Several alternatives are discussed under Section 7.2 above. The only remaining practical alternative would be to raise the level of the dam crest.



CROSS SECTION OF DAM AT GATE HOUSE


2
City of Pawtucket
Arnolds Mills Reservoir
Main Dam and Dike
Topography and Borings
Scales Horizontal 1 inch = 80 feet
Vertical 1 inch = 8 feet
September 14, 1925
Approved
Chief Engineer
DATE
REVISIONS
D1-E2


Cemetery



CITY OF PAWTUCKET

ARNOLDS MILLS RESERVOIR

MAIN DAM & DIKE

BORING RECORDS

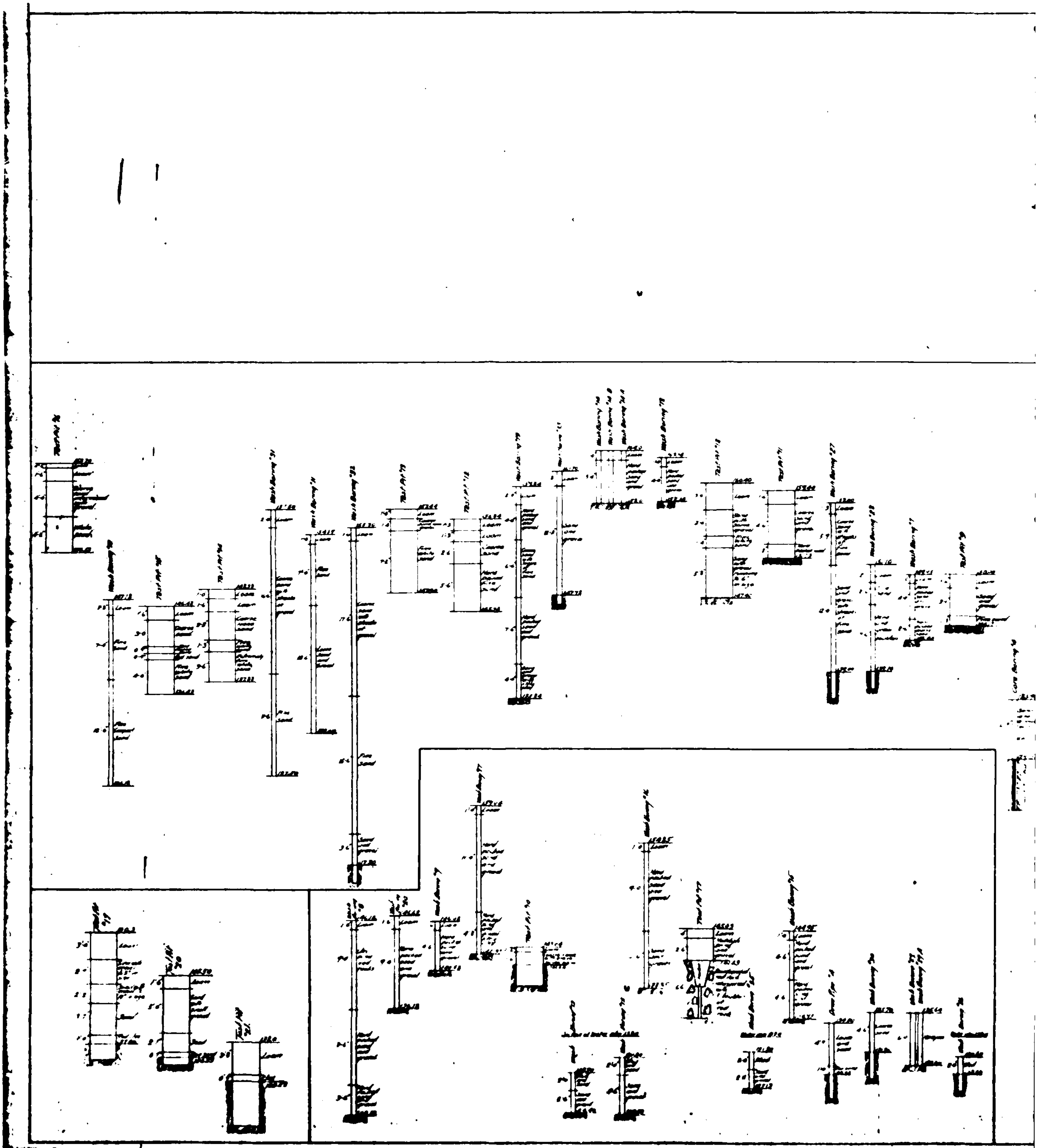
SCALES HORIZONTAL, NOT TO SCALE
VERTICAL, ONE INCH = 5 FEET

SEPT. 28, 1925

APPROVED
CHIEF ENGINEER

6996
85
27

D1-F2-5



R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS

SPECIAL INSPECTION REPORT

DAM NO. 78

INSPECTED BY J. V. KEILY

TOWN – CUMBERLAND

DAM NO 78 NAME ARNOLD'S MILLS RESERVOIR ON BROOK / RIVER BLACKSTONE RIVER / TRENCH WATERSHED BLACKSTONE

OWNER PAWTUCKET WATER WORKS

ADDRESS PAWTUCKET, R. I. City Hall Tel [illegible]

REPORT ON—NEW CONSTRUCTION REPAIRS INSPECTION ONLY X

PLANS BY APPROVED CONTRACTOR

INSPECTION REPORT BY JOHN V. KEILY REASON ROUTINE DATE 10/31/40

TICKLER

SPILLWAY

TYPE

CONDITION

DRAW-OFF GATES

NUMBER

CONDITION

[illegible]HES & WHEELS

EMBANKMENT

CONDITION

APPROACHES

EROSION

BRUSHES & TREES

RIPRAP

PRESENT USE

[illegible] CONTROLS

WHO CONTACTED AT SITE

INSTRUCTIONS LEFT

IN EMERGENCY CALL

EMERGENCY CALL: (Office Pe 3240

1. THOMAS HARDING, CITY ENGR. RES. 25L WILLISTON WAY, PAWTUCKET, RES. TEL. PE. BL. 2903
2. WILLIAM FORTIN, PUBLIC WORKS COMM. RES. 6 WEBSTER ST., PAWT., RES. TEL. PA. 7882

10/31/46

EXTENSIVE EARTH DIKE WITH CONCRETE SPILLWAY AND GATE HOUSE REGULATING RUN-OFF INTO STREAM BELOW. ALL IN GOOD CONDITION; RIP-RAP ON POND SIDE IN FAIR CONDITION.

SEVERAL SMALL TREES STARTING ON EMBANKMENT AND ON POND SIDE AMONG RIP-RAP, SHOULD BE CUT. (Harding so notified)

EMBANKMENT COVERED WITH COARSE SEDGE GRASS AND SHOWS NO EROSION. GOOD FREE BOARD AND POND 2 FEET BELOW CEMENT SPILLWAY LEVEL TO-DAY. SLIGHT SCALING ON FACE OF SPILLWAY AND UPON APRON BELOW.

BUILT 1927.

DATA FROM CITY ENGINEERS OFFICE – JOHN HANNA
5/26/51 DAM ELEVATION – 160.00
STILLING POOL – 136.00 24.00 FT. DROP
TOP OF DAM TO INVERT OF OUTLET PIPE – 30'-0" DROP.
AREA OF RESERVOIR – 11,239,000 SQ. FT.
CONTENTS OF " – 1,156,000,000 GALS.

VISUAL INSPECTION CHECKLIST

Identification No. 803 Name of Dam: Pawtucket Reservoir Dam Sheet 6

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Approx. No. of homes/population	9 homes and old mill building below small dam 1,000' d/s. Route 120 bridge 1100' d/s. Many homes dotting east shore of Rawson Pond Reservoir, 1 mile d/s.
<u>OPERATION & MAINTENANCE FEATURES</u> Reservoir regulation plan, normal conditions	No formal plan. Pawtucket and Diamond Hill (upstream) pools are normally lower by 8' - 10' before hurricane season (August - September).
Reservation regulation plan, emergency conditions	No formal plan. When 6" deep discharge over spillway, caretaker opens 36" Ø gate.
Maintenance features	Limited tree filling and brush cutting on dike.

VISUAL INSPECTION CHECKLIST

Identification No. 803 | Name of Dam: Pawtucket Reservoir Dam | Sheet 5

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
RESERVOIR Shoreline	Gently sloping, wooded, apparently stable. East Dike is heavily wooded.
Sedimentation	None observed.
Upstream hazard areas in event of backflooding	None noted.
Alterations to watershed affecting runoff	Recent reconstruction of Diamond Hill Dam. Inflow to Arnold Mills Reservoir from Diamond Hill drainage area result of flood routing of Diamond Hills inflow.
DOWNSTREAM CHANNEL Constraints on operation of dam	Old Sneech Pond Road bridge and Route 120 bridge 1,100' ± downstream.
Valley section	Wide natural.
Slopes	Wooded.

VISUAL INSPECTION CHECKLIST

Identification No. 803 Name of Dam: Pawtucket Reservoir Dam Sheet 4

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Approach channel	None.
Discharge channel	Natural riverbed leading into pool above small dam at Arnold Mills.
Stilling basin	R.C. with 5 ft. high sill which is spalled and eroded exposing reinforcement. Basin floor covered with accumulation of rocks and debris.
Bridge and piers	None.
Control gates and operating machinery	None.
INSTRUMENTATION Headwater and tailwater gages	None.
Embankment instrumentation	None.
Other instrumentation	Flowmeter in manhole downstream from gate house. Unserviceable due to manhole being full of water.

VISUAL INSPECTION CHECKLIST

Identification No. 803 Name of Dam: Pawtucket Reservoir Dam

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Intake structure	Concrete structure to 24" Ø intake just visible below water appeared in good condition. 48" Ø intake not seen.
Outlet structure	R.C. twin box outlet with R.C. headwall and wingwalls. Headwall and wingwalls seriously eroded and deteriorated by freeze/thaw action. Concrete edges of roof of gate house damaged by freeze/thaw action.
Outlet channel	Natural stream bed, brush and tree covered.
Drawdown facilities	One 24" Ø gate and three 36" Ø gates. One 36" Ø gate stuck open, remainder serviceable.
SPILLWAY STRUCTURES Concrete weir	Surface cracked and spalled. Vertical construction joints said to leak when reservoir elevation is higher. Horizontal construction joints at left side seep when reservoir is high, probably owing to poor construction cleanup at lift placement. 24" flashboards, 30' ± missing.

VISUAL INSPECTION CHECKLIST

Identification No. 803 Name of Dam: Pawtucket Reservoir Dam Sheet 2

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
Riprap slope protection	Grouted riprap in fair to good condition.
Seepage	Several seepage points noted near toe of embankment between left abutment and spillway and near outlet structure.
Piping or boils	None observed.
Junction of embankment and abutment, spillway and dam	18" deep erosion next to concrete spillway abutment on east side. Slight erosion of D/S slope at abutment on west side.
Foundation drainage	None.
OUTLET WORKS Approach channel	N/A
Outlet conduit concrete surfaces	N/A

VISUAL INSPECTION CHECKLIST

Identification No. 803 Name of Dam: Pawtucket Reservoir Dam Sheet 1

VISUAL EXAMINATION OF	OBSERVATIONS AND REMARKS
EMBANKMENT Vertical alignment and movement	No movement observed.
Horizontal alignment and movement	No movement observed.
Unusual movement or cracking at or near the toe	None observed.
Surface cracks	None observed.
Animal burrows and tree growth	No burrows noted. Mature trees and brush recently cut on upstream face and crest of main dam west of spillway. Main dam east of spillway covered with mature trees and brush along crest and upstream and downstream faces. Tree and brush growth covers dike to west of main dam.
Sloughing or erosion of slopes	None evident.

VISUAL INSPECTION
PHASE I

Identification No. 803 Name of Dam: Pawtucket Reservoir Dam

Date of Inspection: 27 September 1978

Weather: sunny, clear Temperature: $60^{o}F \pm$

Pool Elevation at Time of Inspection: 152.7 MSL

Tailwater Elevation at Time of Inspection: $132\pm$ MSL

INSPECTION PERSONNEL

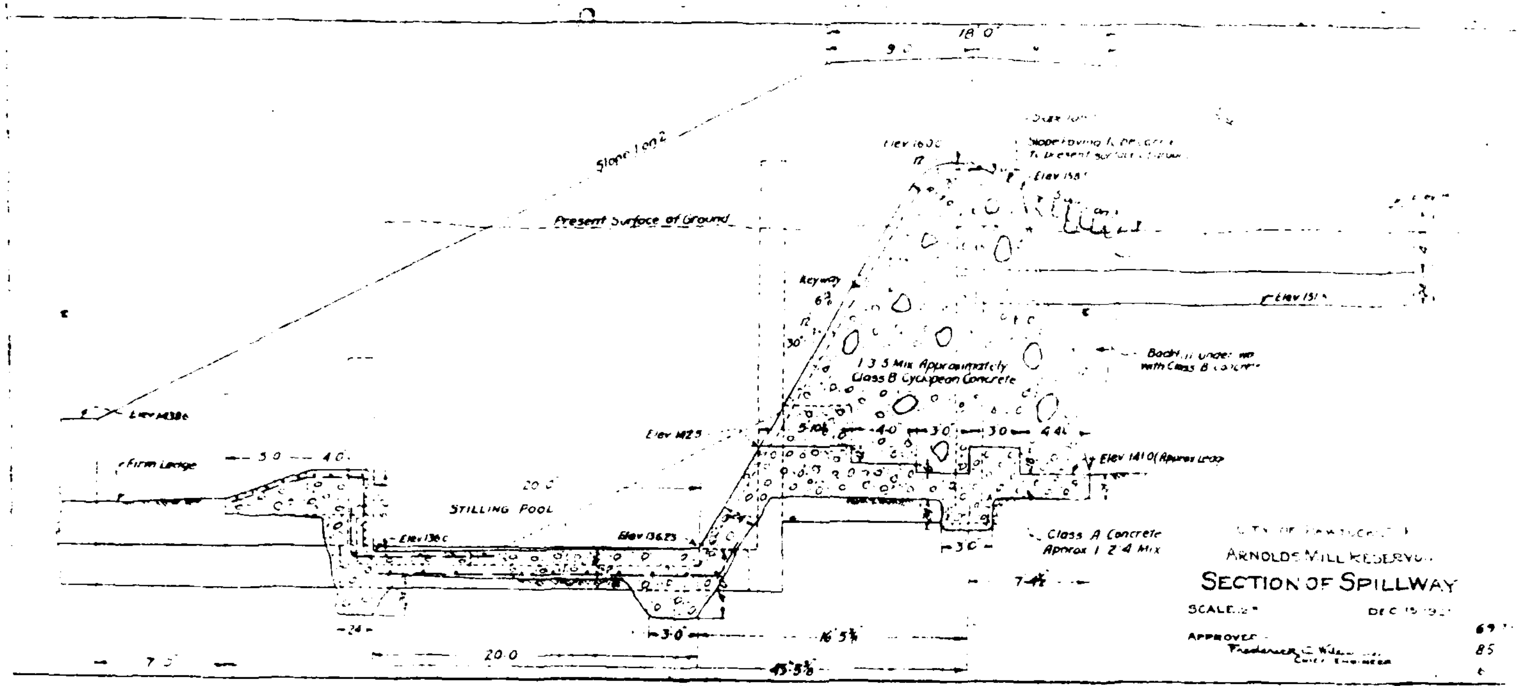
Peter B. Dyson	Louis Berger & Associates, Inc.	Project Manager
Carl J. Hoffman	Louis Berger & Associates, Inc.	Hydraulics, Structures
Thomas C. Chapter	Louis Berger & Associates, Inc.	Hydrology, Soils
William S. Zoino	Goldberg Zoino Dunnicliff & Assoc., Inc.	Soils

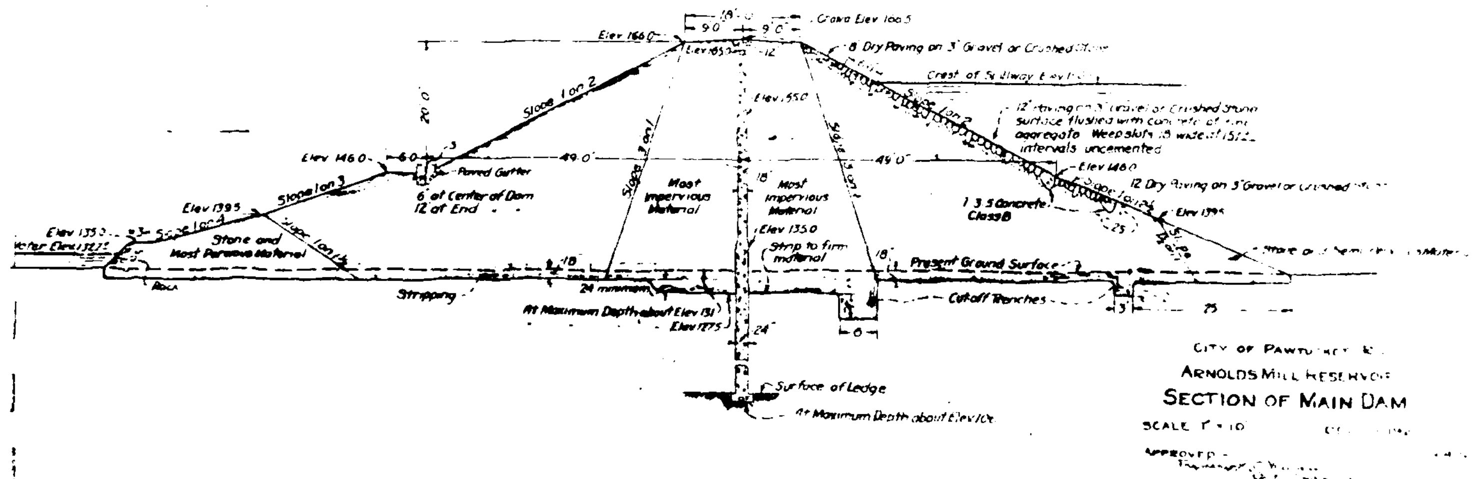
OWNER'S REPRESENTATIVES

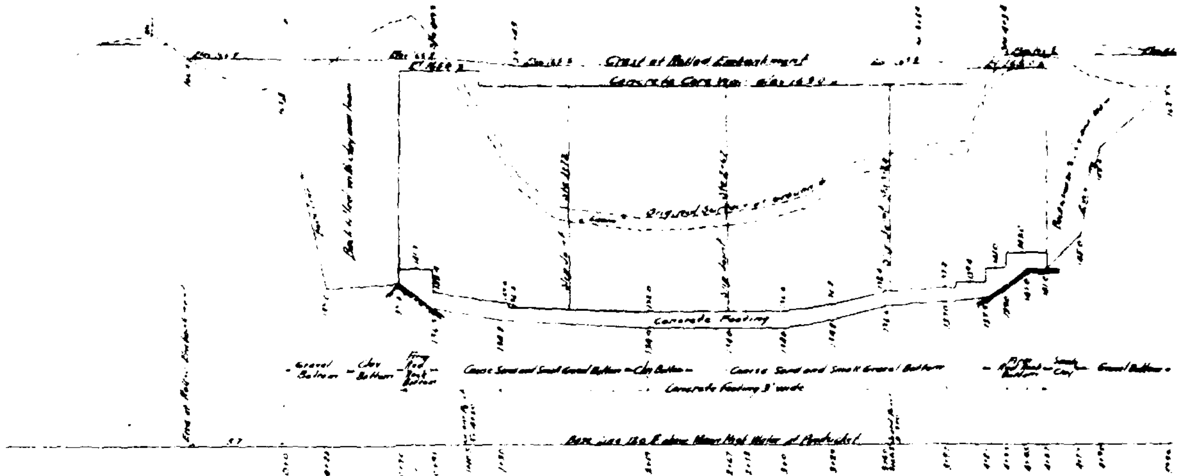
Robert P. Blouvelt	Water Supply Board City of Pawtucket	Chief Engineer
Russell Knibb	Water Supply Board City of Pawtucket	Supervisor of Water Supply
Alfred Delude	Water Supply Board City of Pawtucket	Caretaker

APPENDIX A

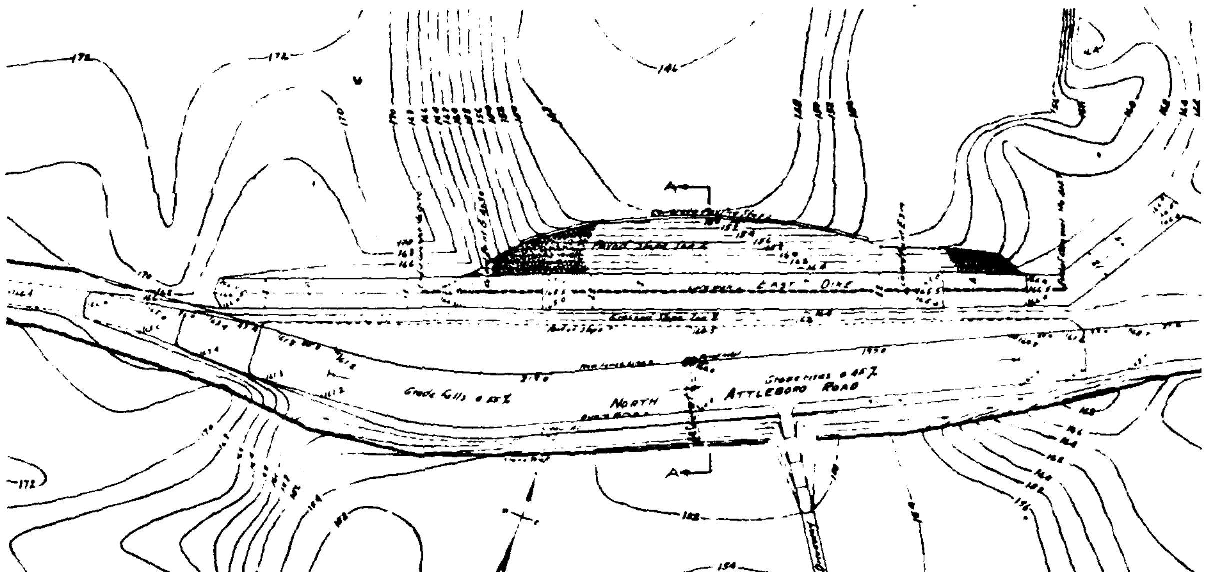
VISUAL INSPECTION CHECKLIST


City of Pawtucket R.I.
Arnolds Mill Reservoir
Section of Spillway
Approved
Frederick C. Wilson, Chief Engineer
Slope 1 on 2
Present Surface of Ground
Elev 160.0
Elev 151.5
Keyway
1:3:5 Mix Approximately Class B Cyclopean Concrete
Backfill under with Class B Concrete
Elev 142.5
Elev 141.0 (Approx Ledge)
Firm Ledge
Stilling Pool
Elev 136.0
Elev 136.25
Class A Concrete Approx 1:2:4 Mix
20.0
45'5⅜"

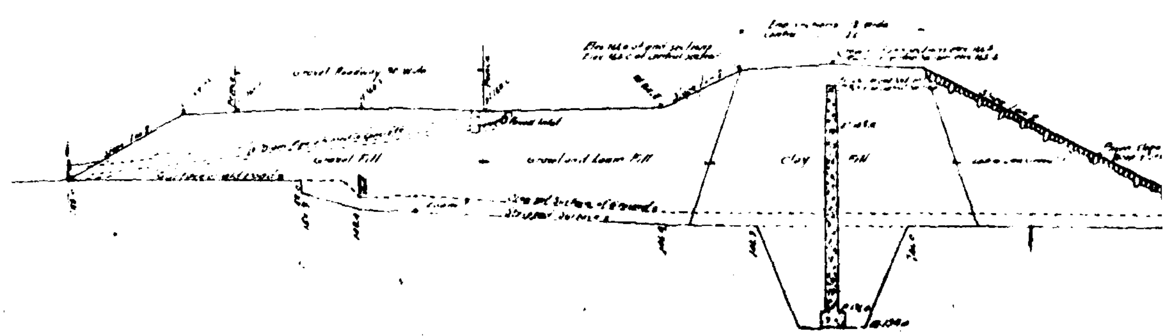

City of Pawtucket R.I.
Arnolds Mill Reservoir
Section of Main Dam
Scale 1" = 10'
Approved
Crown Elev 166.5
Elev 166.0
8 Dry Paving on 3" Gravel or Crushed Stone
Crest of Spillway
Slope 1 on 2
Elev 155.0
12" Paving on 3" Gravel or Crushed Stone surface flushed with concrete of fine aggregate. Weep slots ½ wide at 15' 12' intervals uncemented
Elev 146.0
Paved Gutter
6" at Center of Dam 12" at End
Slope 3 on 1
Most Impervious Material
Elev 135.0
Strip to firm material
1:3:5 Concrete Class B
12 Dry Paving on 3" Gravel or Crushed Stone
Elev 139.5
Slope 1 on 3
Stone and Most Pervious Material
Present Ground Surface
Stripping
24 minimum
At Maximum Depth about Elev 131
Elev 127.5
Cutoff Trenches
Surface of Ledge
At Maximum Depth about Elev 10x
Rock



PROFILE ON CENTER LINE OF EAST DIKE
HOR. SCALE ONE INCH = 40 FEET
VERT " " " = 8 "



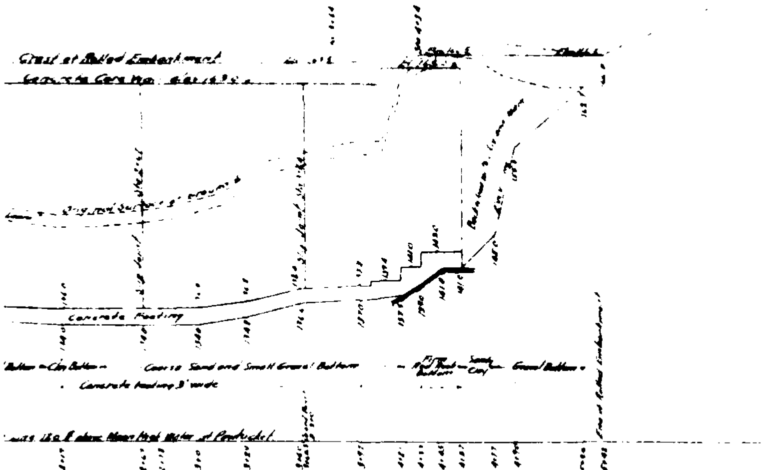
PLAN
SCALE ONE INCH = 40 FEET



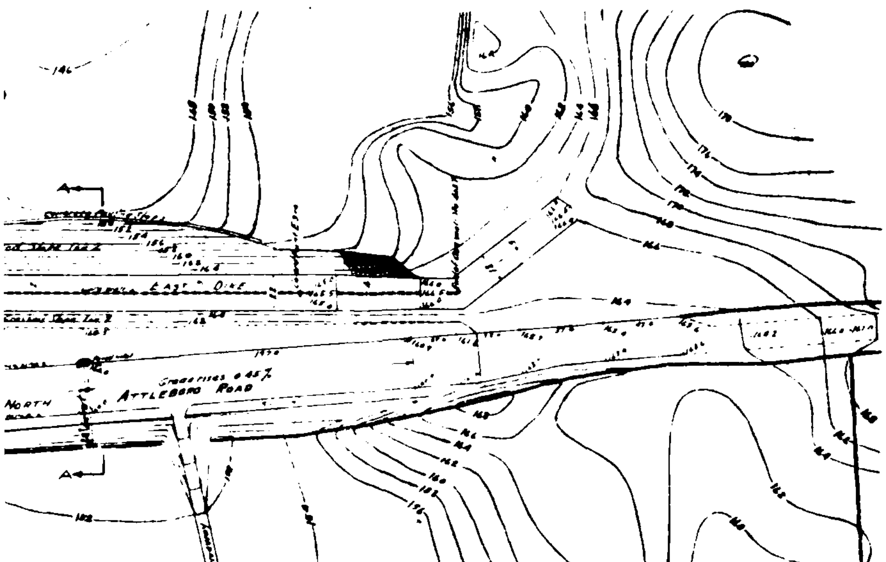
SECTION A A
SCALE ONE INCH = 8 FEET

08730

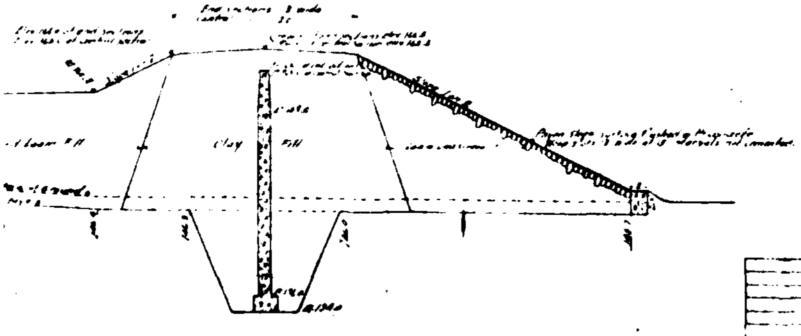
2



ILE ON CENTER LINE OF EAST DIKE
SCALE ONE INCH = 40 FEET
VERT 8



PLAN
SCALE ONE INCH = 40 FEET



SECTION AA
SCALE ONE INCH = 8 FEET

DATE	REVISIONS

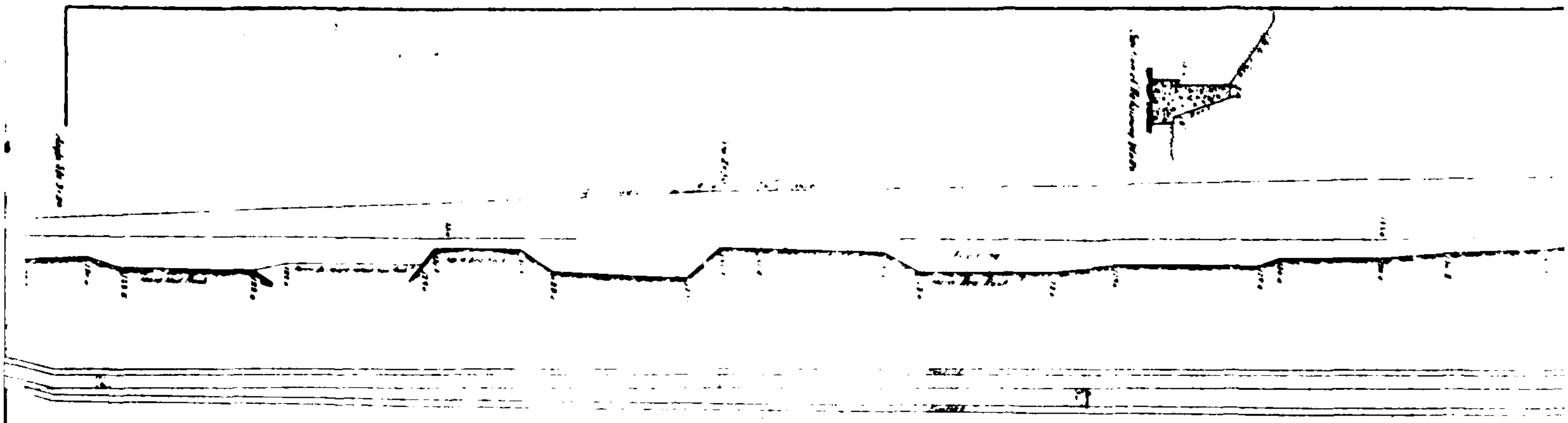
CITY OF PAWTUCKET
ARNOLDS MILLS PROJECT
PLAN, PROFILE AND SECTION
OF EAST DIKE AND
NORTH ATTLEBORO ROAD

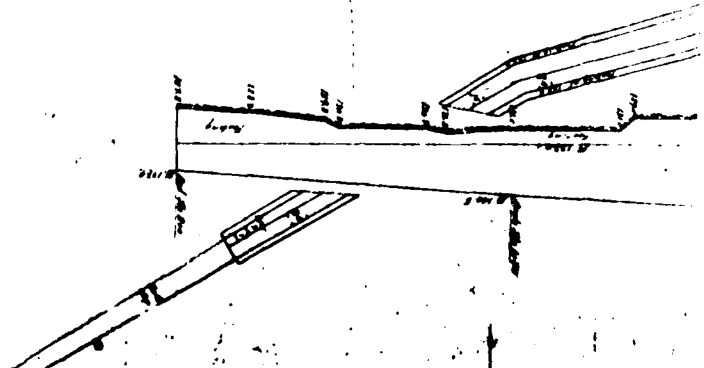
SCALES AS SHOWN

OCTOBER 1927.

APPROVED
7001 CHIEF ENGINEER
85
32

D1-F2-10





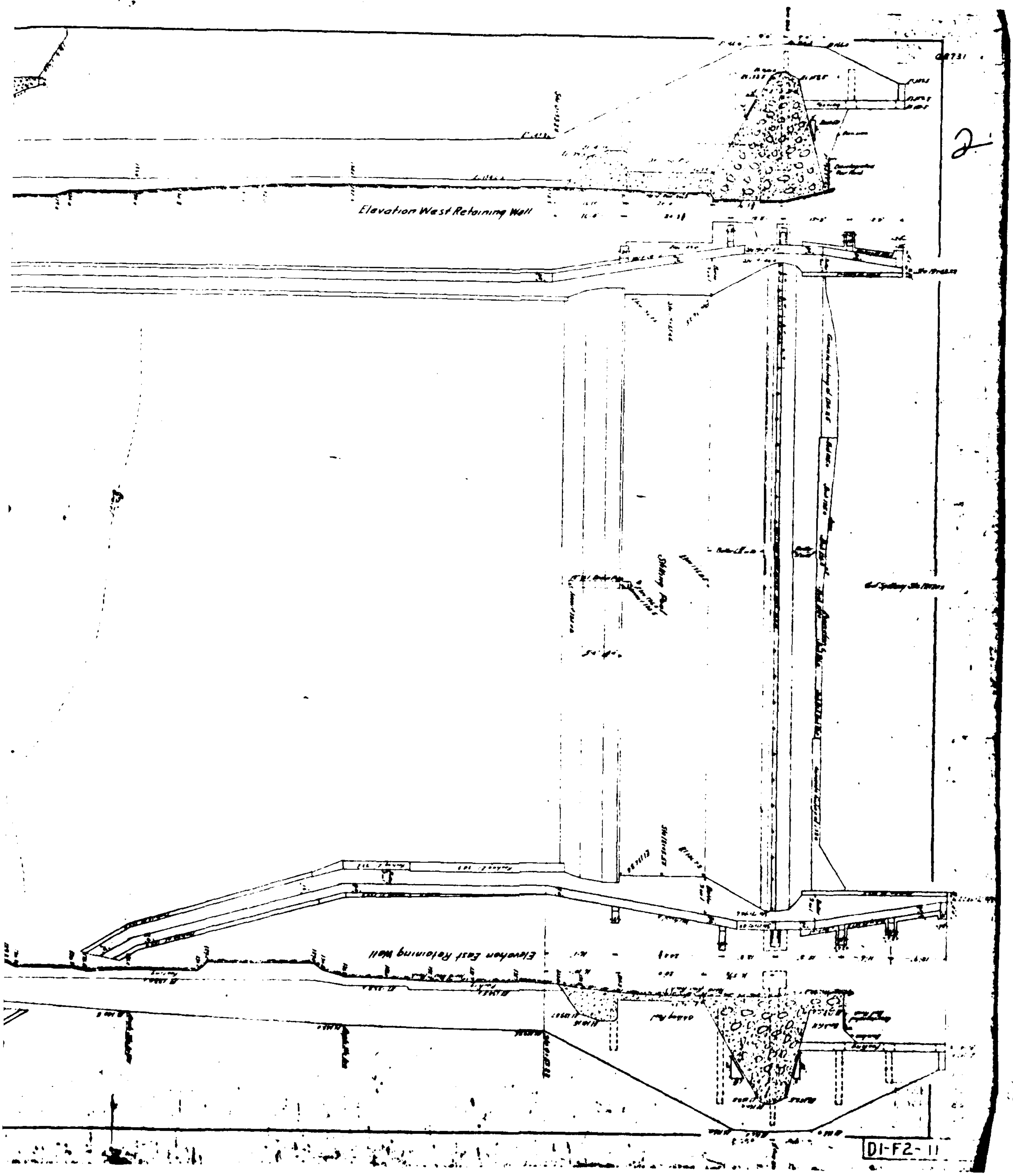
CITY OF PAWTUCKET.
ARNOLDS MILLS PROJECT
MAIN DAM AND DIKE.
DETAILS OF SPILLWAY.

SCALE ONE INCH = 10 FEET.

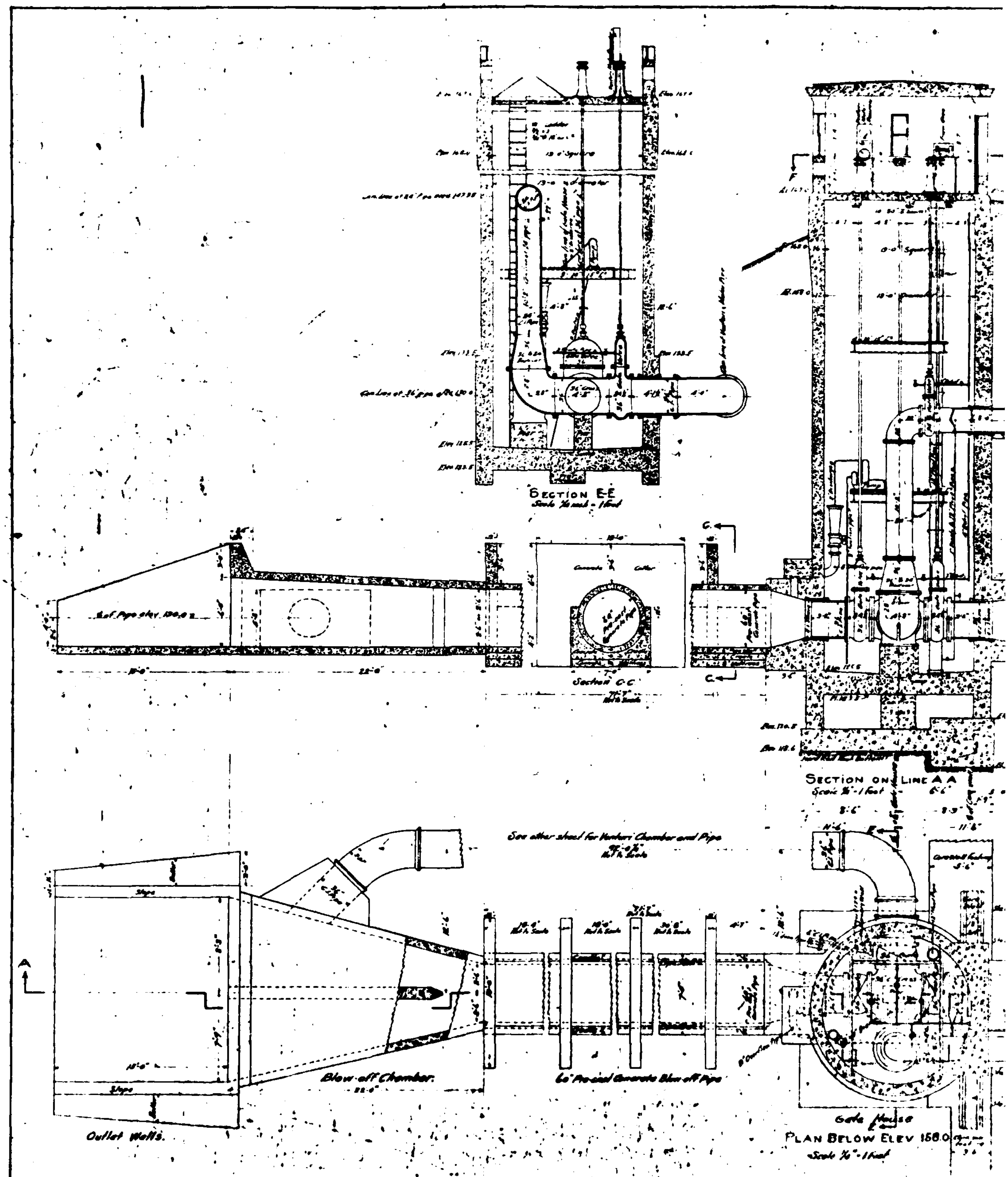
AUGUST 1927

APPROVED ______________
CHIEF ENGINEER.

DATE	REVISIONS

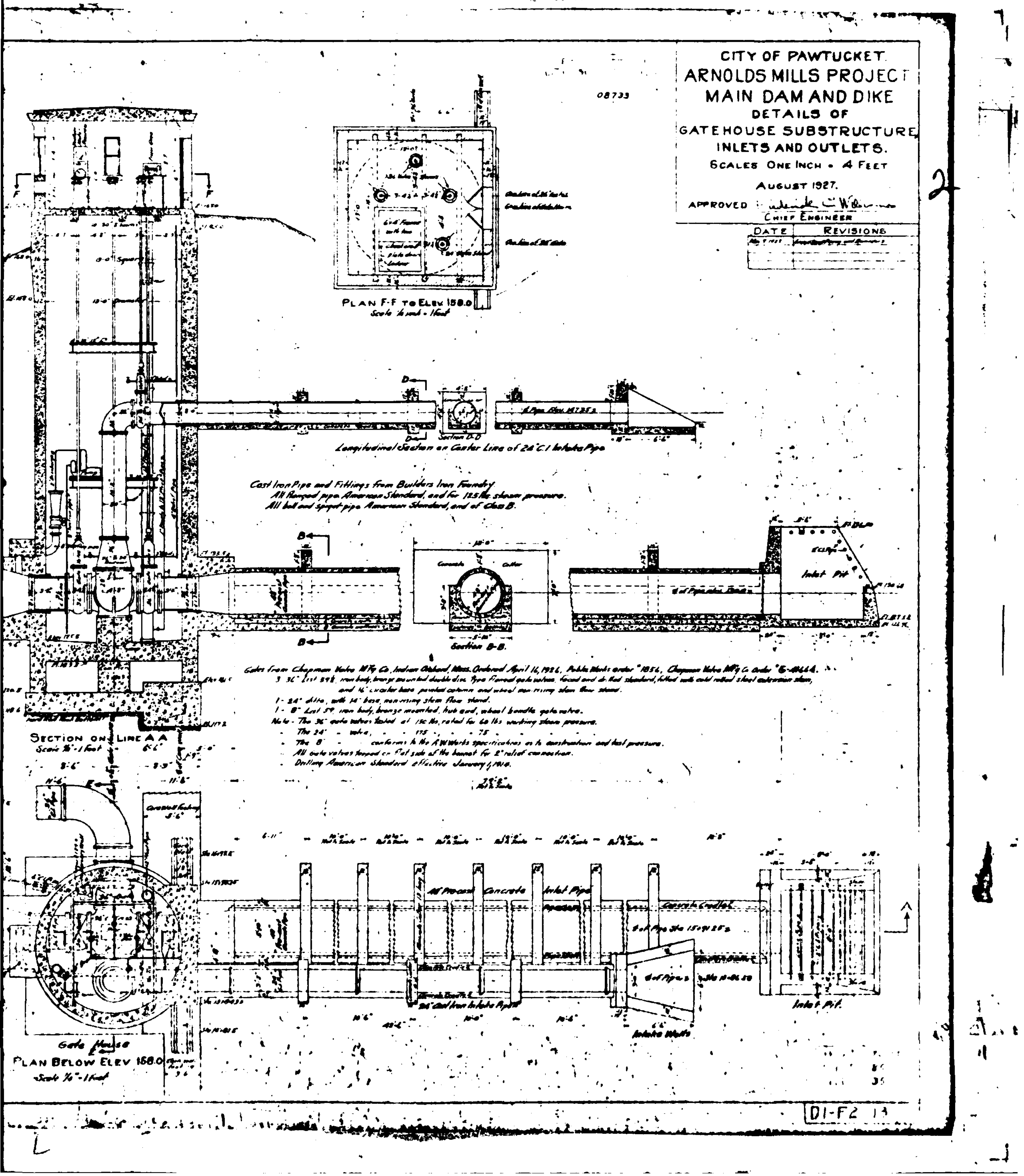

Elevation West Retaining Wall
Elevation East Retaining Wall
2
DI-F2-11

L

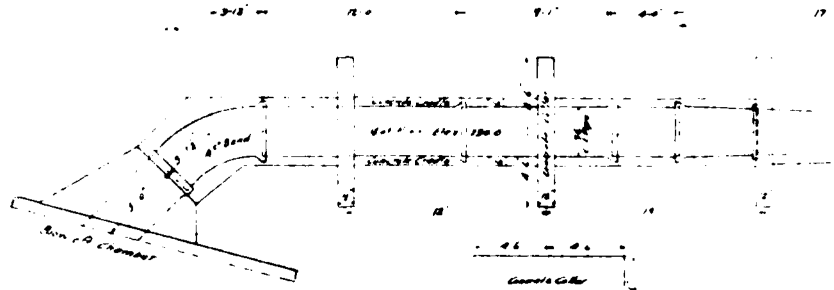


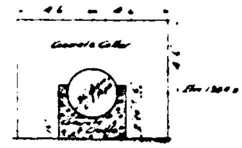
Section E-E
Section C-C
Section on Line A A
See other sheet for Venturi Chamber and Pipe
Blow-off Chamber
60" Pre-cast Concrete Blow-off Pipe
Outlet Wells
Gate House
Plan Below Elev 158.0

L

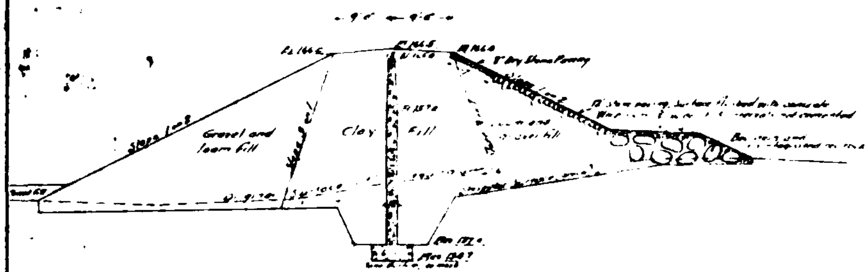


CITY OF PAWTUCKET
ARNOLDS MILLS PROJECT
MAIN DAM AND DIKE
DETAILS OF
GATEHOUSE SUBSTRUCTURE
INLETS AND OUTLETS.
SCALES ONE INCH = 4 FEET
AUGUST 1927.
APPROVED
CHIEF ENGINEER
DATE
REVISIONS
08733
PLAN F-F TO ELEV 158.0
Section D-D
Longitudinal Section on Center Line of 24" C.I. Intake Pipe
Cast Iron Pipe and Fittings from Builders Iron Foundry
All flanged pipe American Standard, and for 125 lbs. steam pressure.
All bell and spigot pipe American Standard, and of Class B.
Concrete
Collar
Section B-B.
Inlet Pit
Gates from Chapman Valve Mfg Co., Indian Orchard, Mass. Ordered April 16, 1926, Public Works order #1856, Chapman Valve Mfg Co. order #6-40664.
3 36" List 598 iron body, bronze mounted double disc type flanged gate valves, faced and drilled standard, fitted with cold rolled steel extension stem, and 16" circular base pivoted column and wheel non-rising stem floor stand.
1 - 24" ditto, with 14" base, non-rising stem floor stand.
1 - 8" List 59 iron body, bronze mounted, hub end, wheel handle gate valve.
Note - The 36" gate valves tested at 150 lbs, rated for 60 lbs working steam pressure.
The 24" valve, 175, 75
The 8" conforms to the R.W. Works specifications as to construction and test pressure.
All gate valves tapped on flat side of the bonnet for 2" relief connection.
Drilling American Standard effective January 1, 1914.
SECTION ON LINE A-A
Scale 1/4" = 1 foot
All Precast Concrete Inlet Pipe
Concrete Cradle
24" Cast Iron Intake Pipe
Intake Works
Inlet Pit
Gate House
PLAN BELOW ELEV 158.0
Scale 1/4" = 1 foot
DI-F2 13

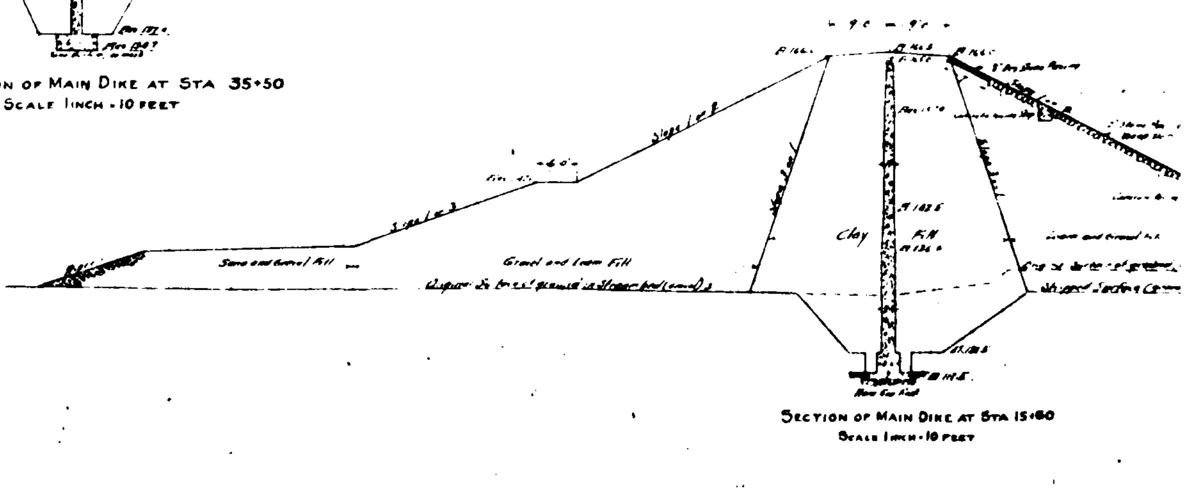




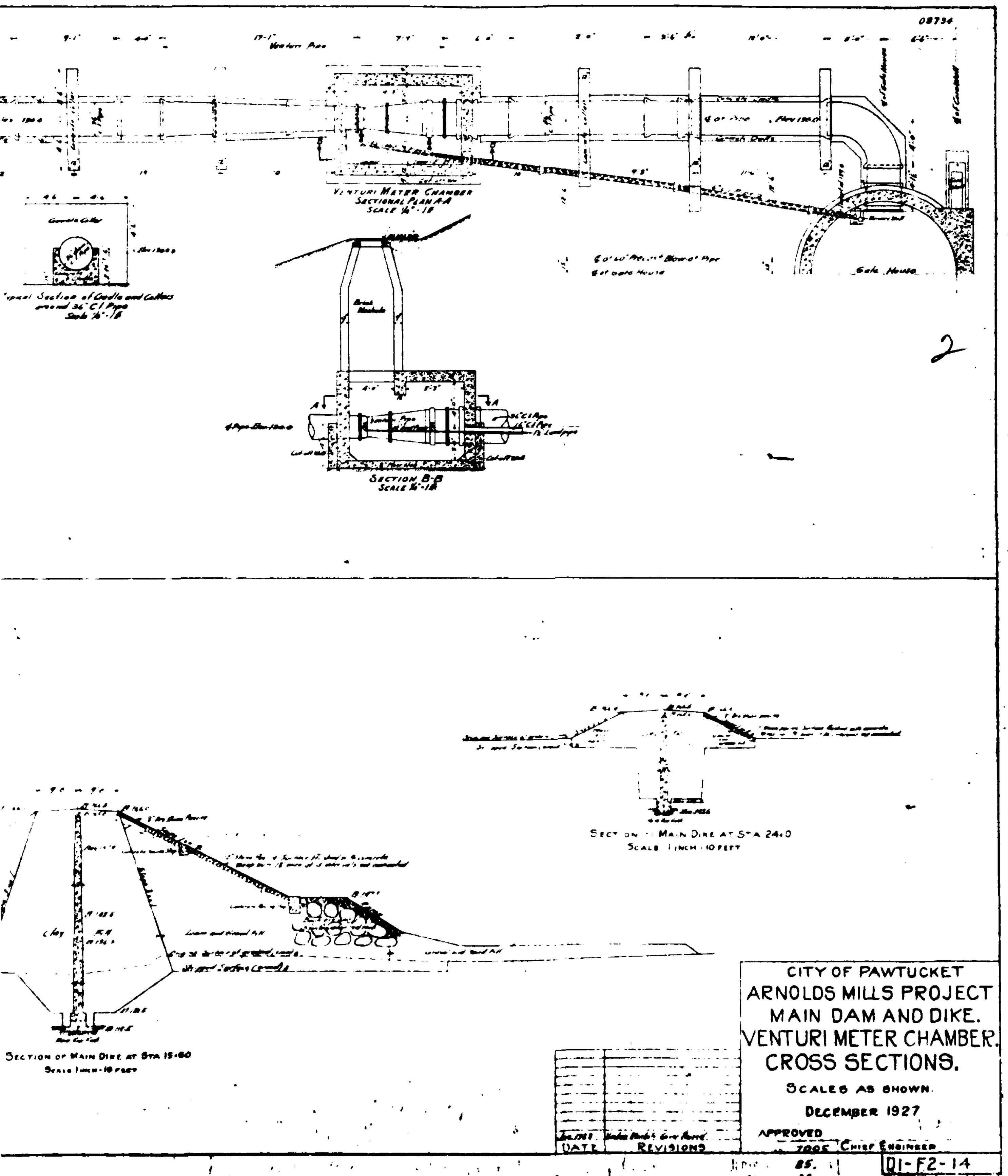
Typical Section of Cradle and Collars around 36" C.I. Pipe Scale ½" - 1'



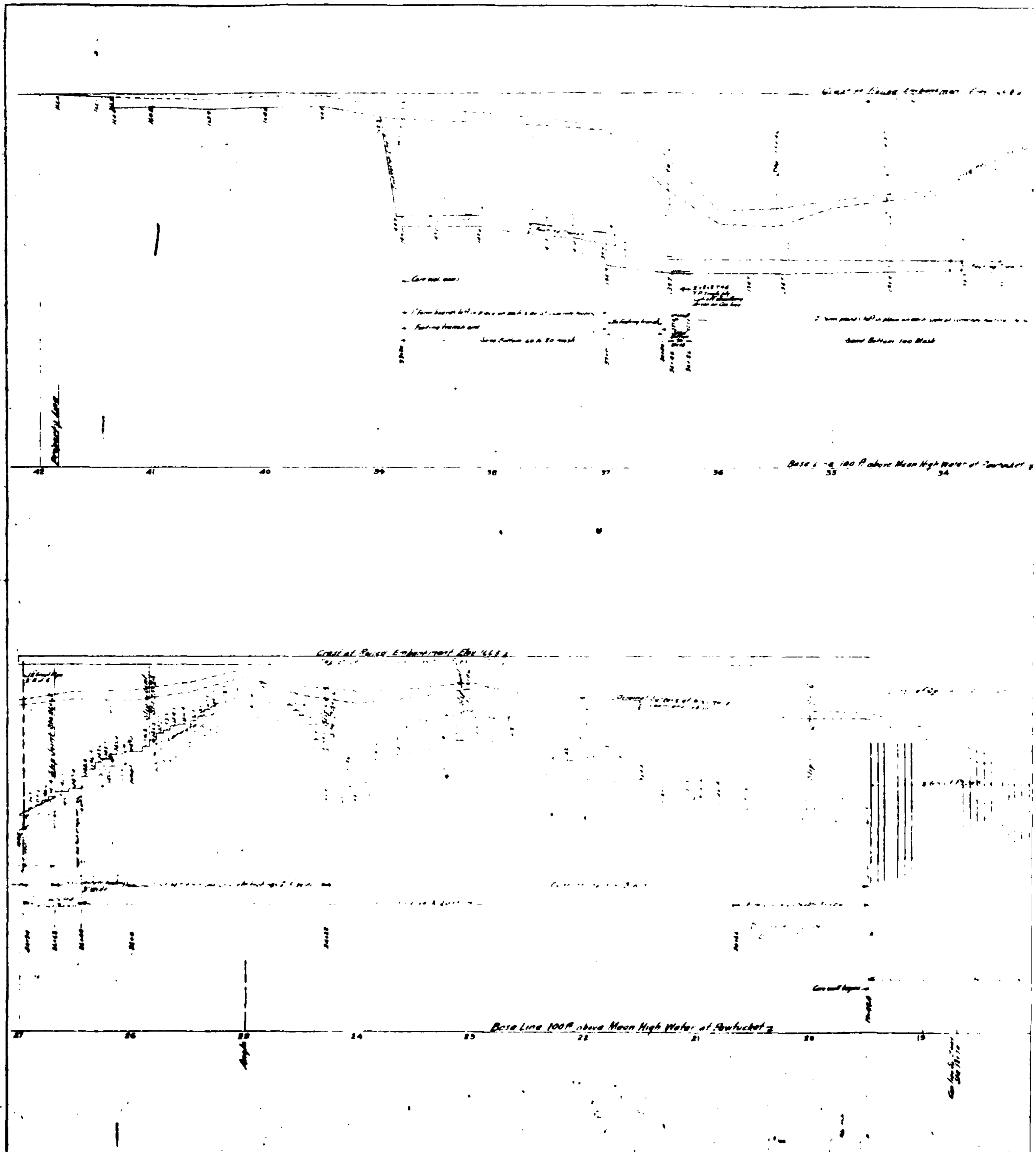
SECTION OF MAIN DIKE AT STA 35+50
SCALE 1 INCH = 10 FEET



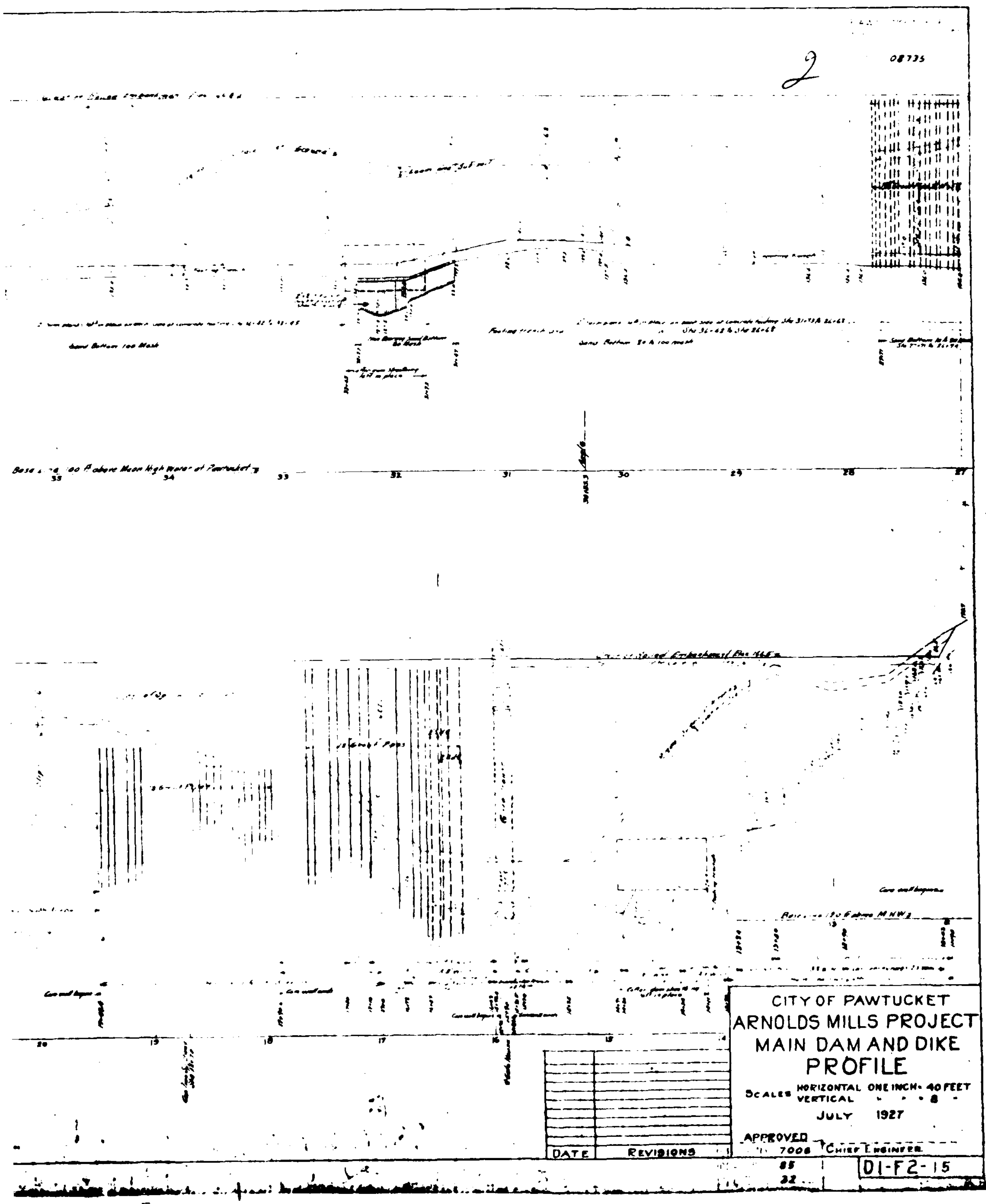
SECTION OF MAIN DIKE AT STA 15+60
SCALE 1 INCH = 10 FEET

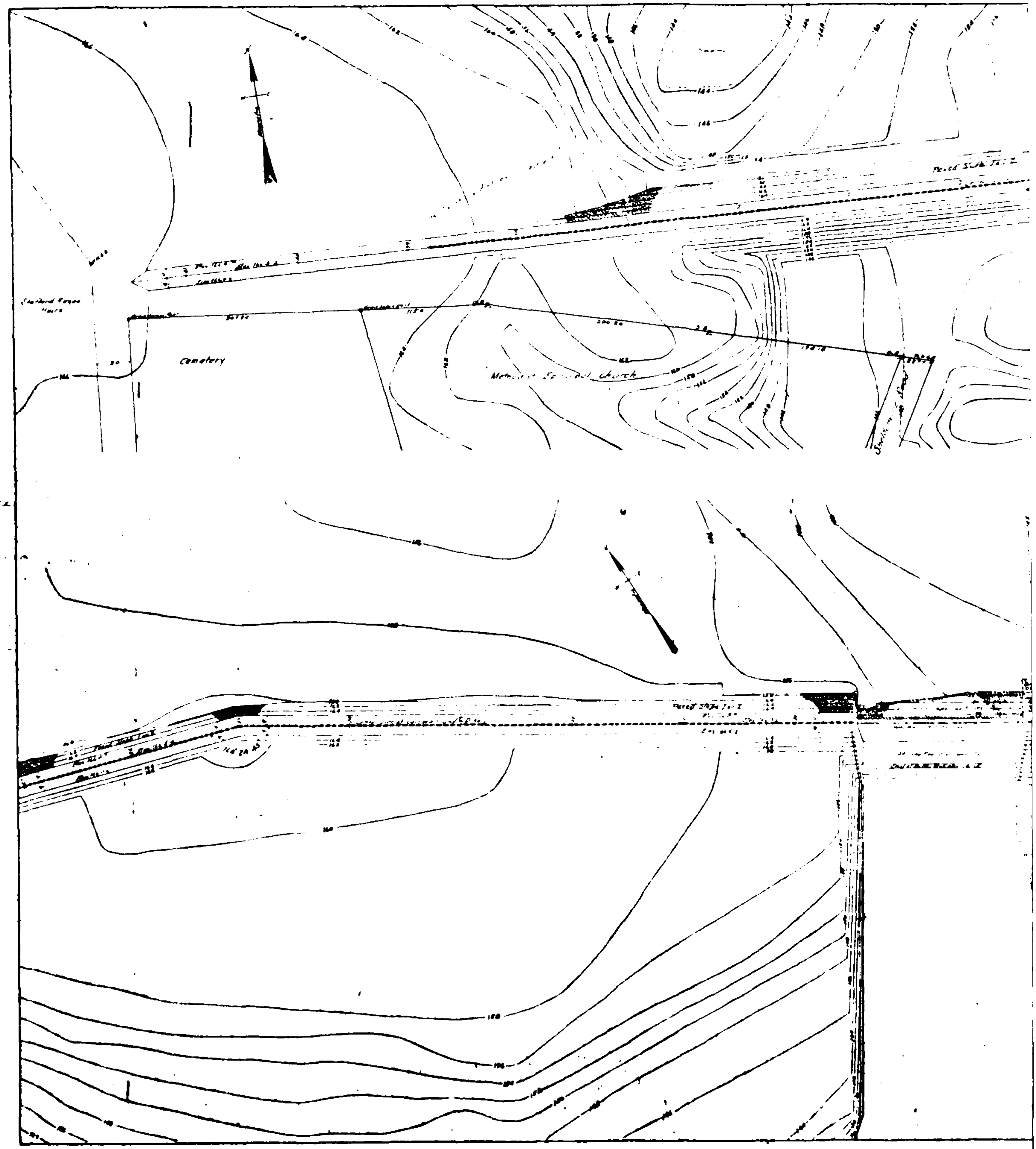


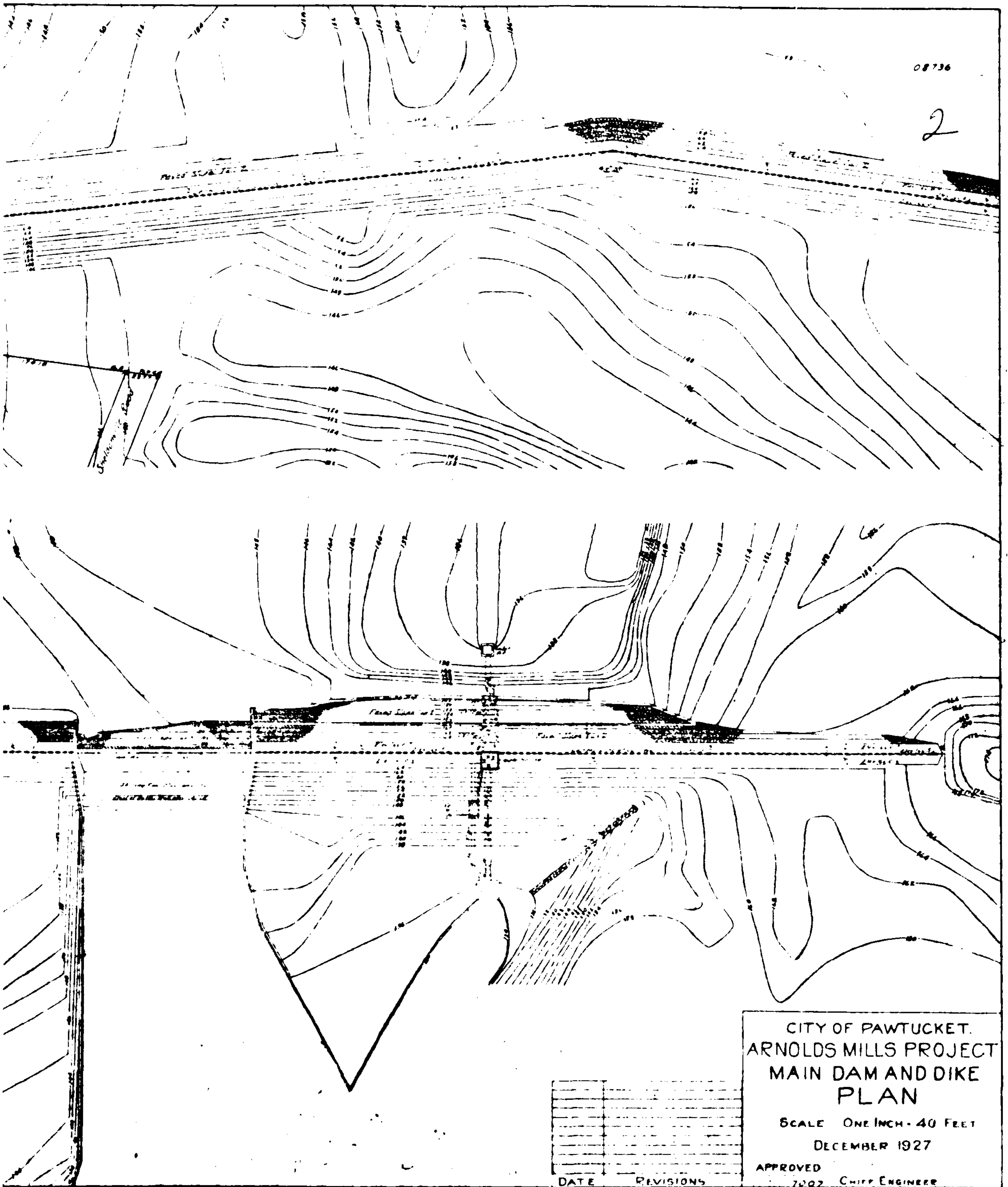
08734
Venturi Pipe
VENTURI METER CHAMBER
SECTIONAL PLAN A-A
SCALE 1/4"-1 ft
Gate House
Brick Manhole
Typical Section of Cradle and Collars around 36" C.I. Pipe
Scale 1/4"-1 ft
SECTION B-B
SCALE 1/4"-1 ft
2
SECTION OF MAIN DIKE AT STA 24+0
SCALE 1 INCH - 10 FEET
Clay
SECTION OF MAIN DIKE AT STA 15+60
SCALE 1 INCH - 10 FEET
CITY OF PAWTUCKET
ARNOLDS MILLS PROJECT
MAIN DAM AND DIKE.
VENTURI METER CHAMBER.
CROSS SECTIONS.
SCALES AS SHOWN.
DECEMBER 1927
APPROVED
CHIEF ENGINEER
DATE
REVISIONS
DI-F2-14

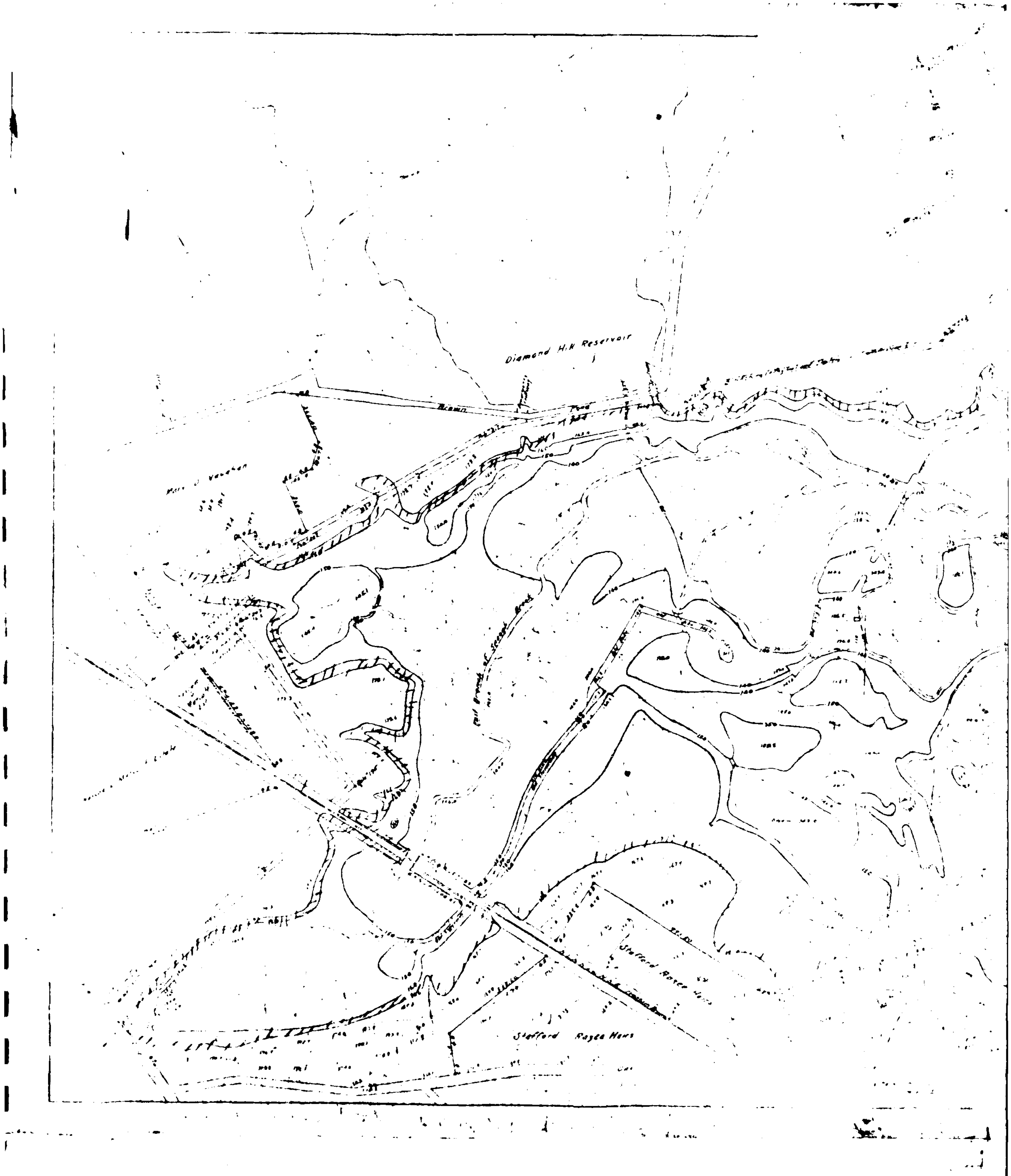


Property Line
Sand Bottom 100 Mesh
Base Line 100 ft above Mean High Water at Pawtucket
42
41
40
39
38
37
36
35
34
Crest of Raised Embankment Elev 465
Base Line 100 ft above Mean High Water at Pawtucket
27
26
25
24
23
22
21
20
19


08735
CITY OF PAWTUCKET
ARNOLDS MILLS PROJECT
MAIN DAM AND DIKE
PROFILE
SCALES HORIZONTAL ONE INCH = 40 FEET
VERTICAL
JULY 1927
APPROVED
7008
CHIEF ENGINEER
DATE
REVISIONS
D1-F2-15


Cemetery


08736
2
CITY OF PAWTUCKET.
ARNOLDS MILLS PROJECT
MAIN DAM AND DIKE
PLAN
SCALE ONE INCH - 40 FEET
DECEMBER 1927
APPROVED
CHIEF ENGINEER
DATE
REVISIONS
85
38
DI-F2-16


Diamond Hill Reservoir

LOUIS BERGER & ASSOCIATES INC.

BY K. DATE ______ SHEET NO. ______ OF ______

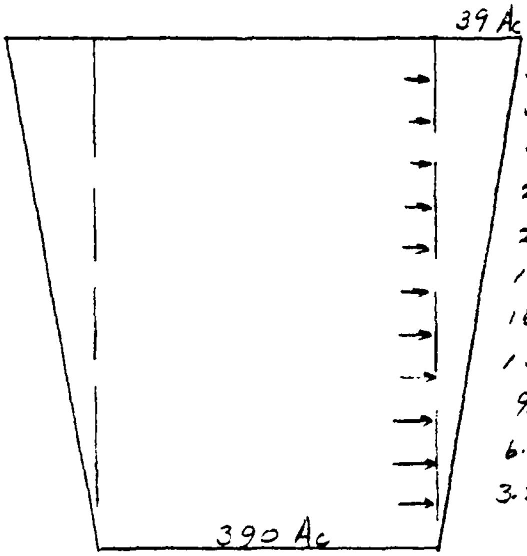
CHKD. BY ______ DATE 12/9 Diamond Hill PROJECT D-189

SUBJECT Surcharge Storage Capacity

Planimetered Areas - Elev. datum = MSL

Lake at El. 198 - 390 Acres

Contour El. 210 - 468 Acres



El		Sur. Stor. Cap.
210	39 Ac	5148 AcFt.
209	35.75	4683
208	32.5	4225
207	29.25	3548
206	26	3328
205	22.75	2889
204	19.5	2457
203	16.25	2031
202	13	1612
201	9.75	1199
200	6.5	793
199	3.25	393
198	390 Ac	

BY [illegible] DATE [illegible]

LOUIS BERGER & ASSOCIATES INC.

CHKD. BY ______ DATE ______

PAWTUCKET RESERVOIR #3 [illegible]

SHEET NO. ______ OF ______

PROJECT [illegible]

SUBJECT Diamond Hill Unitgraph

$T_p = Lag + D/2 = 3.16$ $D = .5\ hr$

$Q_p = \dfrac{484\ AQ}{T_p} = 1290$ $A = 8.42$ sq. mi.

Time	T/Tp	Q/Qp	Discharge
[illegible]	.16	.051	66
	.32	.184	237
[illegible]	.47	.385	497
2	.63	.651	840
[illegible]	.79	[illegible]	1123
3	.95	[illegible]	1271
3.[illegible]	1.11	.974	[illegible]
[illegible]	1.27	.864	[illegible]
[illegible]	1.42	.732	944
[illegible]	1.58	.58	748
[illegible]	1.74	.462	596
[illegible]	1.9	.37	477
[illegible]	2.06	.296	382
[illegible]	2.22	.234	302
[illegible]	2.37	[illegible]	244
[illegible]	2.53	[illegible]	[illegible]
[illegible]	2.69	[illegible]	144
[illegible]	2.85	[illegible]	[illegible]
[illegible]	3.01	[illegible]	96
[illegible]	3.16	[illegible]	81
[illegible]	3.32	[illegible]	[illegible]
11	3.48	[illegible]	49
[illegible]	3.64	.0310	40
[illegible]	3.79	[illegible]	33
[illegible]	3.95	[illegible]	[illegible]
[illegible]	4.11	[illegible]	21
[illegible]	4.27	[illegible]	17
[illegible]	4.43	[illegible]	[illegible]
14.[illegible]	4.59	[illegible]	[illegible]
[illegible]	4.75	[illegible]	[illegible]
[illegible]	4.91	[illegible]	[illegible]
[illegible]	5.06	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

BY ______ DATE ______ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ______ OF ______

CHKD. BY ______ DATE ______ Diamond [illegible] # 3 PROJECT [illegible]

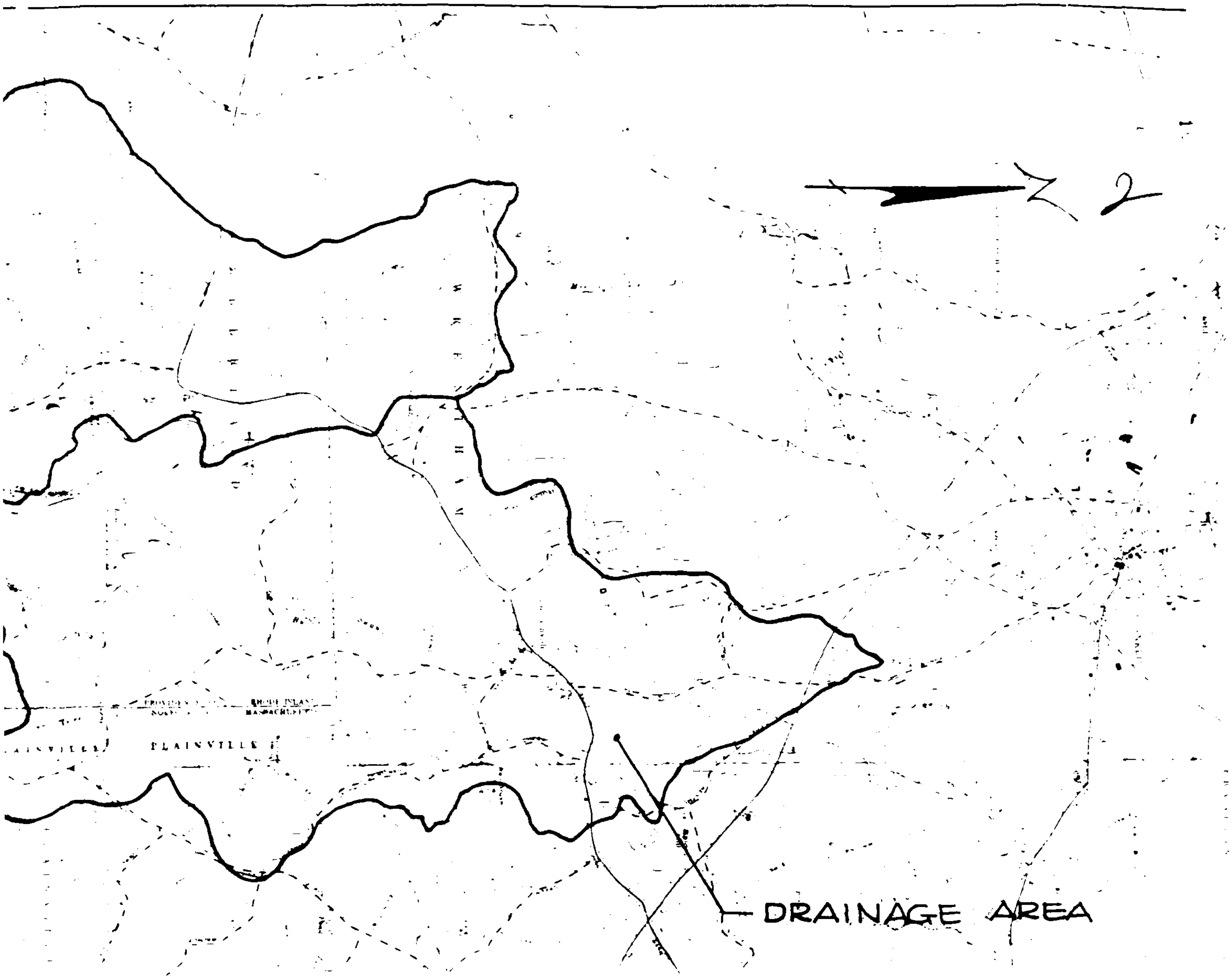
SUBJECT Precipitation Data

Drainage Area = 8.42 sq. mi.
24 hr, 200 sq. mi. PMP = 22 in.
6 hr, 10 sq. mi. PMP = 24.3 in.
20% reduction for basin fit = 19.4 in.

Time	%	Precip.	Δ	Rea Δ	Infil	Runoff
.50	27	5.24	5.24	0.97	0.05	0.92
1	38	7.37	2.13	0.97		0.92
.5	46	8.92	1.55	1.16		1.11
2	53	10.28	1.36	1.17		1.12
.5	60	11.64	1.36	1.36		1.31
3	67	13	1.36	1.55		1.50
.5	73	14.16	1.16	2.13		2.08
4	79	15.33	1.17	5.24		5.19
.5	84.5	16.39	1.06	1.36		1.31
5	90	17.46	1.07	1.36		1.31
.5	95	18.43	0.97	1.07		1.02
6	100	19.4	0.97	1.06		1.01

T_c [illegible] 1.5 [illegible] PDC≤3
[illegible] 26.59 [illegible]

T_c = [illegible] = 4.85 [illegible] = 0.91



JCKET RESERVOIR DAM

LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PAWTUCKET RESERVOIR DAM
(ARNOLD MILLS)

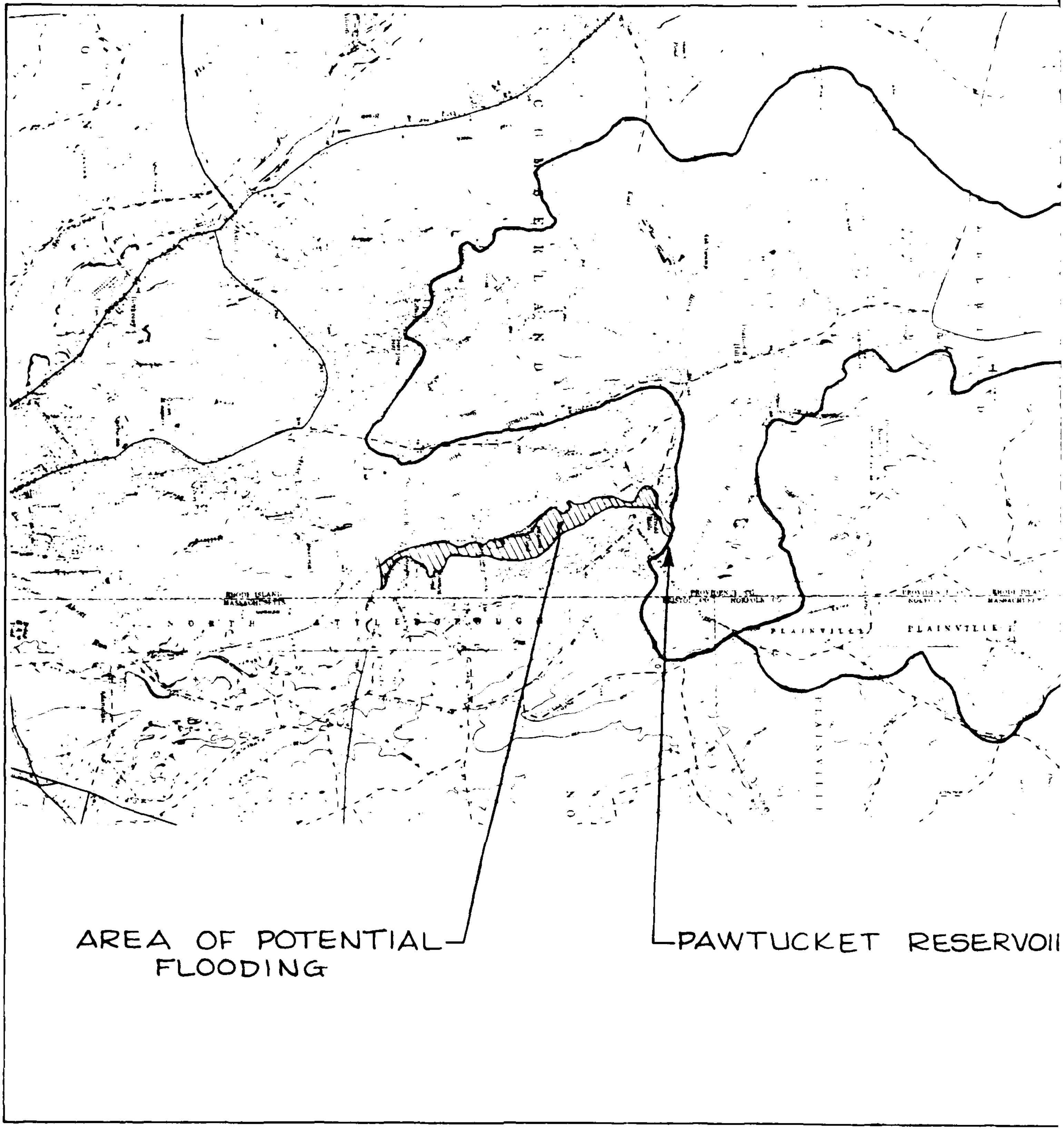
DRAINAGE AREA AND AREA
OF POTENTIAL FLOODING

STATE - R.I.

SCALE 1:24000

DATE

D-


AREA OF POTENTIAL
FLOODING
PAWTUCKET RESERVOI

APPENDIX D

HYDRAULIC & HYDROLOGIC COMPUTATIONS

9. Upstreat face of East Dike

10. Brush on East Dike

7. Upstream face of concrete spillway

8. Outlet conduit headwall

5. Detail of downstream face of concrete spillway

6. Concrete sill to stilling basin

PAWTUCKET RESERVOIR DAM

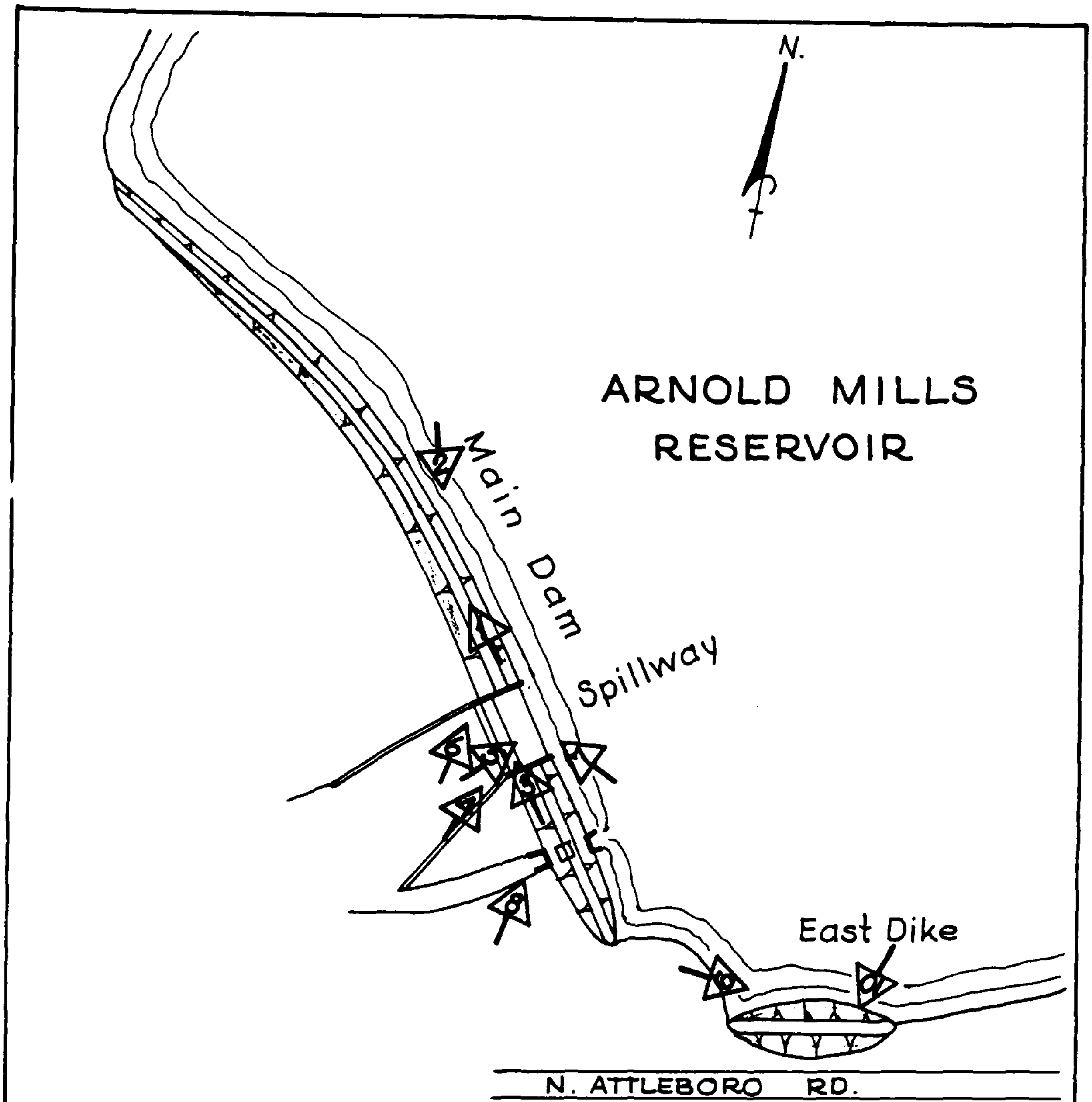
3. Spillway and stilling basin

4. Downstream face of spillway

PAWTUCKET RESERVOIR DAM

1. Main embankment right of spillway

2. Upstream face of embankment right of spillway



Appendix 'C' Photos

Overview Photos

LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PAWTUCKET RESERVOIR DAM (ARNOLD MILLS)

SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS

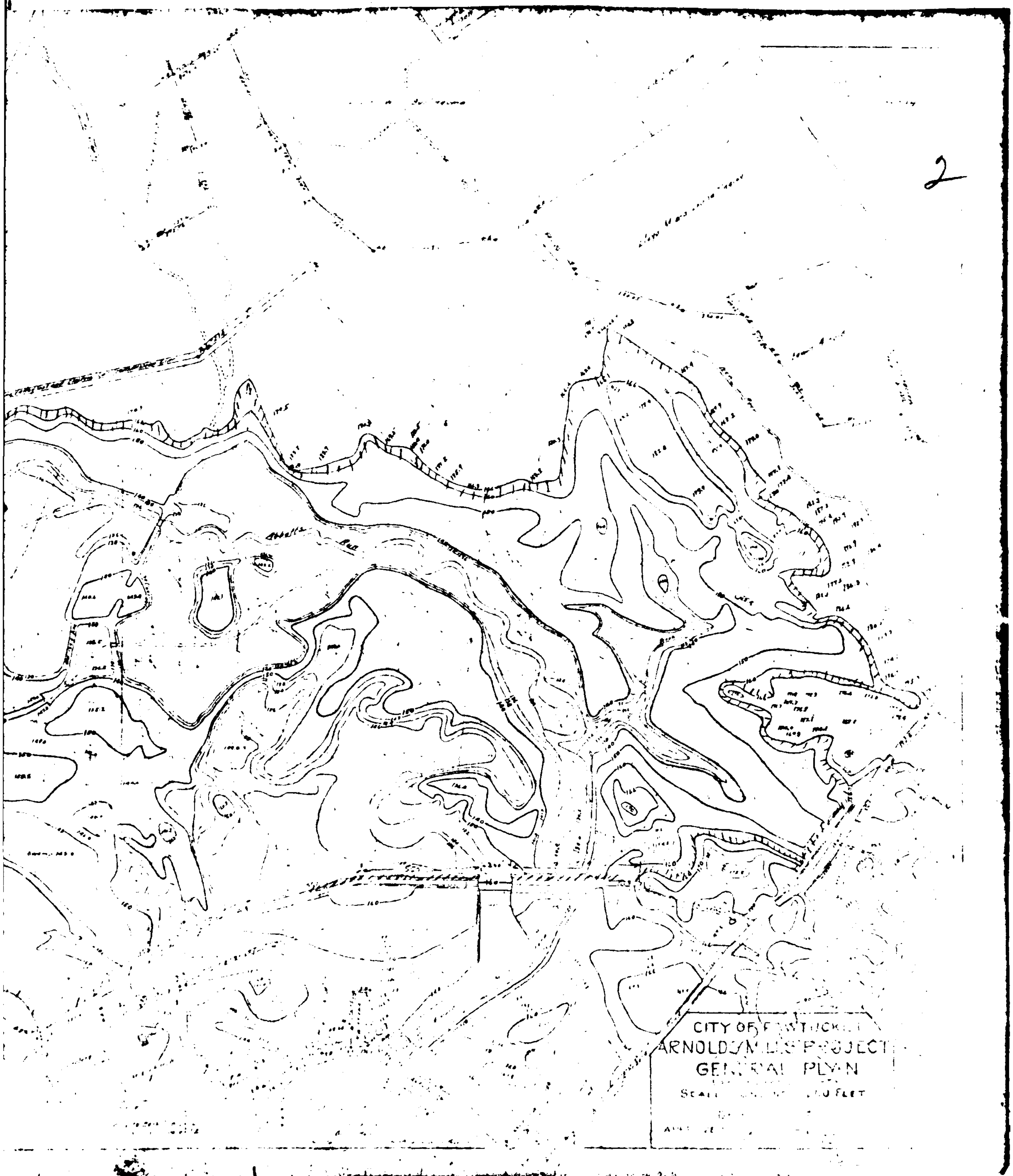
STATE- R.I.

			SCALE 1:24000
			DATE

APPENDIX C

SELECTED PHOTOGRAPHS

2



BY KB DATE 12/12 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ Pawtucket Reservoir PROJECT W-189

SUBJECT Lag & Unitgraph

Tc based on avg. vel. of 1.5 fps per Texas RDC&B.

L = 23021' H = 128' Slp = .6%

$T_c = \dfrac{23021}{1.5 \times 3600} = 4.26$ hrs Lag = $0.6\,T_c$ = 2.56 hrs

Unit time = .5 hr T_p = Lag + D/2 = 2.81 hrs.

Time	T/Tp	Q/Qp	Discharge
.5	.18	.063	98
1.0	.36	.232	201
1.5	.53	.481	749
2	.71	.788	1226
2.5	.89	.962	1498
3	1.07	.986	1535
3.5	1.25	.880	1370
4	1.42	.732	1140
4.5	1.6	.56	872
5	1.78	.434	676
5.5	1.96	.34	529
6	2.14	.264	411
6.5	2.31	.207	322
7	2.49	.158	246
7.5	2.67	.119	185
8	2.85	.092	143
8.5	3.03	.073	114
9	3.21	.059	92
9.5	3.38	.045	70
10	3.56	.034	53
10.5	3.74	.027	42
11	3.92	.021	33
11.5	4.10	.016	25
12	4.27	.013	20
12.5	4.45	.010	16
13.	4.63	.008	12
13.5	4.81	.006	9
14	4.99	.004	6
14.5	5.16	.003	5

BY ___ DATE 9/29 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

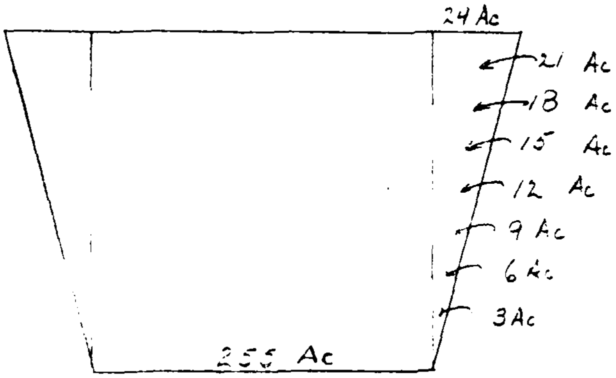
CHKD. BY ____ DATE ____ PAWTUCKET RESERVOIR PROJECT 2189

SUBJECT Surcharge Storage Capacity

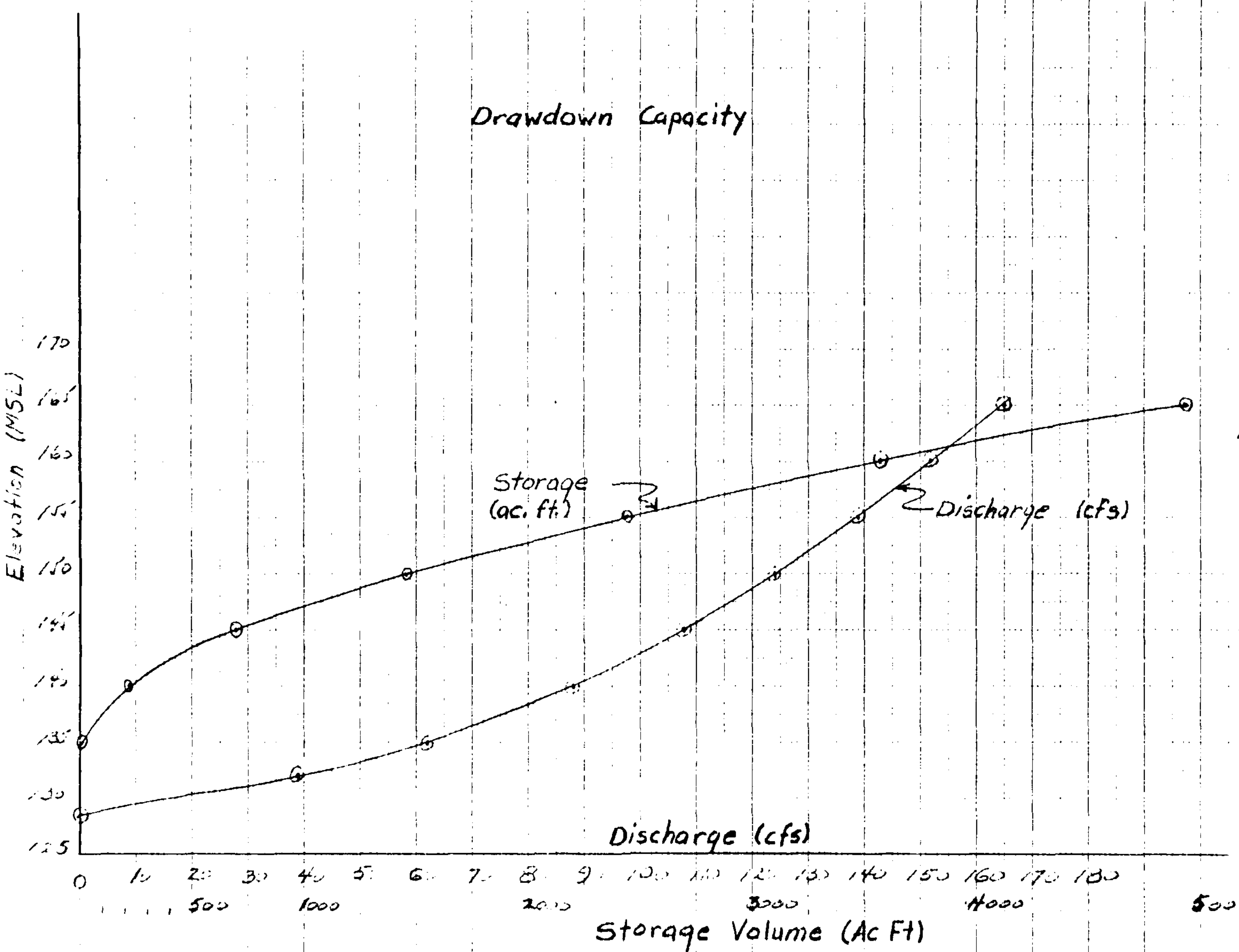
Planimetered Areas — Elev datum = MSL

Lake @ El. 162 — 255 Ac

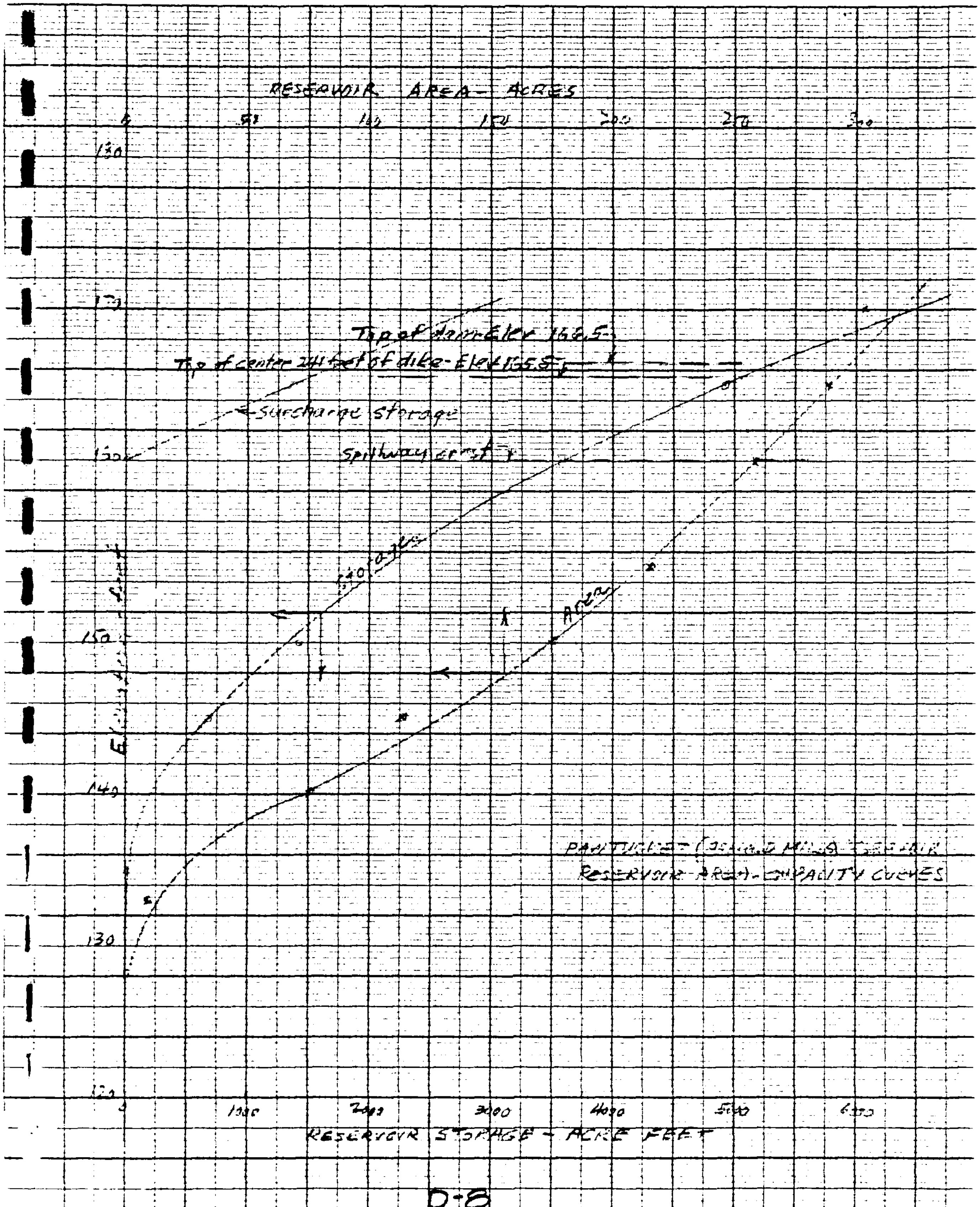
Contour El. 170 — 303 Ac



El.	Sur Stor Cap.	
170	2232	Ac Ft
169	1932	"
168	1638	"
167	1350	"
166	1068	"
165	792	"
164	522	"
163	258	"
162	0	"



Vol.	DD
1357	4.3
1184	4.1
976	3.8
720	3.1
471	2.4
210	1.4
12	.1

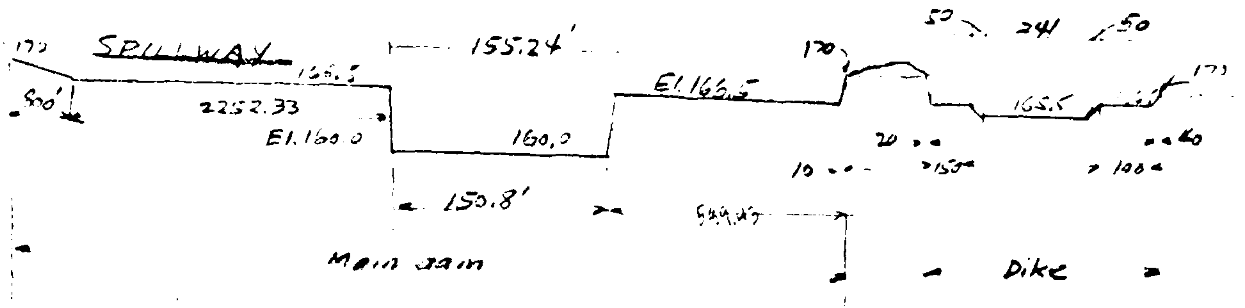

RESERVOIR AREA - ACRES
0
50
100
150
200
250
300
Top of dam Elev 168.5
Top of center 241 feet of dike - Elev 165.5
Surcharge storage
Spillway crest
Capacity
Area
150
140
130
0
1000
2000
3000
4000
5000
6000
RESERVOIR STORAGE - ACRE FEET
RESERVOIR AREA - CAPACITY CURVES

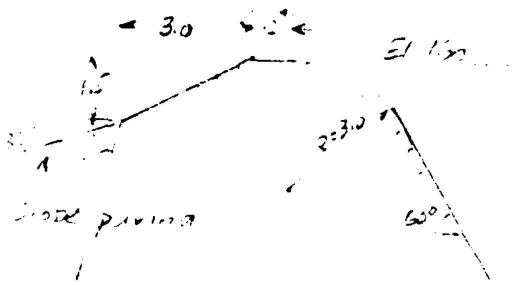
BY J.H. DATE 9-20-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ______ DATE ______ INSPECTION OF DAMS CONN. + R.I. PROJECT ______

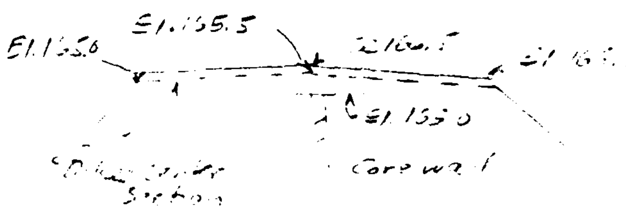
SUBJECT PAWTUCKET (ARNOLD MILL) DAM - #8

DISCHARGE OVER SPILLWAY + DAM





Spwy cross section

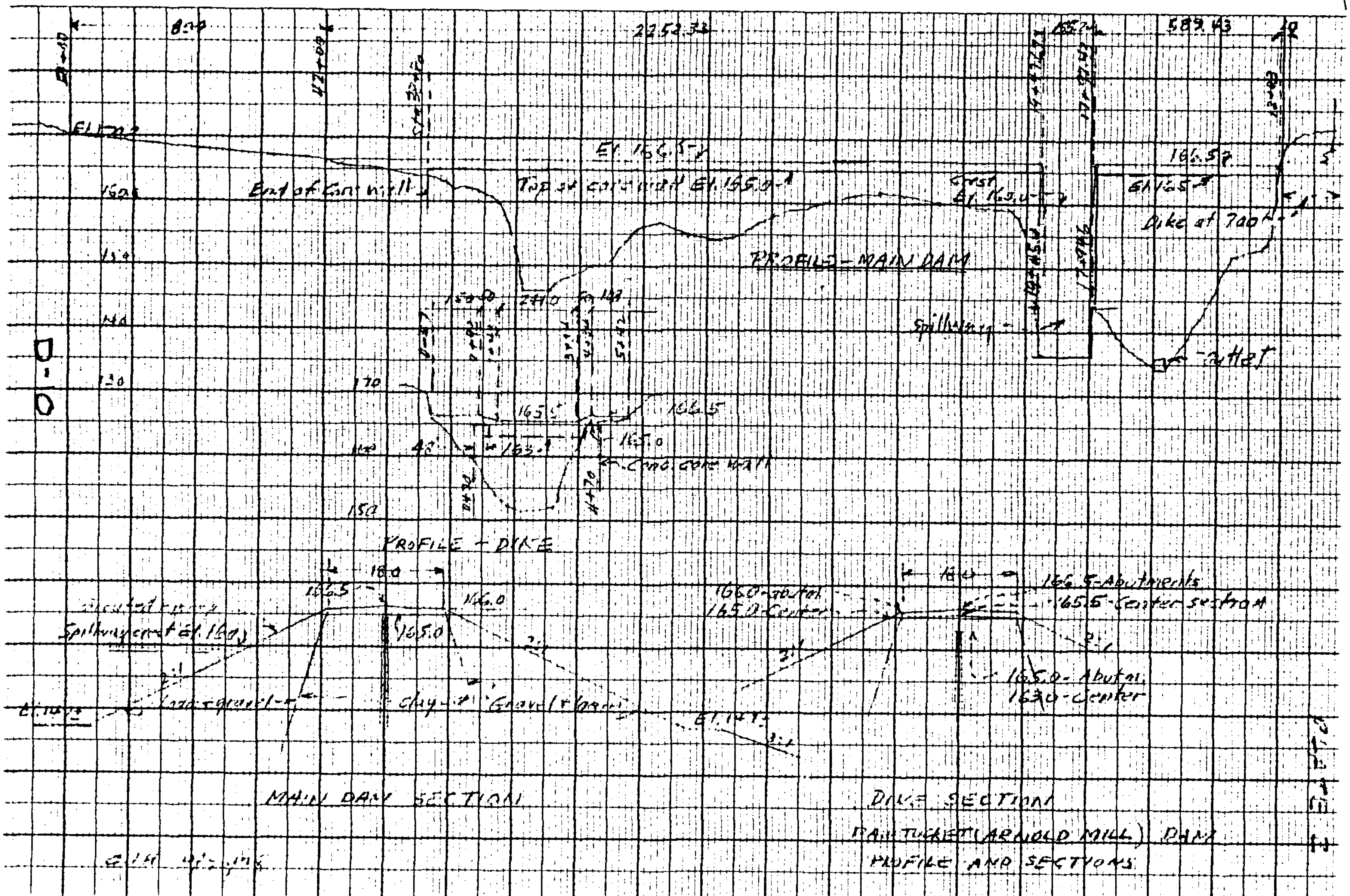


DAM CROSS SECTION

RESERVOIR - AREA - CAPACITY

Elevation	Area Ac	Av Area	H	Δ Vol Ac ft	Σ vol	Surcharge Storage above spwy crest
128	0					
130	—	0.1	2	0.2	0.2	
135	8.8	2.5	5	12.4	12.6	
140	75.2	42.0	5	210.2	222.8	
145	113.2	94.2	5	4709	693.7	
150	174.6	143.9	5	719.5	1413.2	
155	215.6	195.1	5	975.5	2388.7	
160	258	236.8	5	1183.9	3572.6	0
165	288	271.5	5	1357.4	4930.0	1357
170	317	302.5	5	1512.5	6442.5	2870

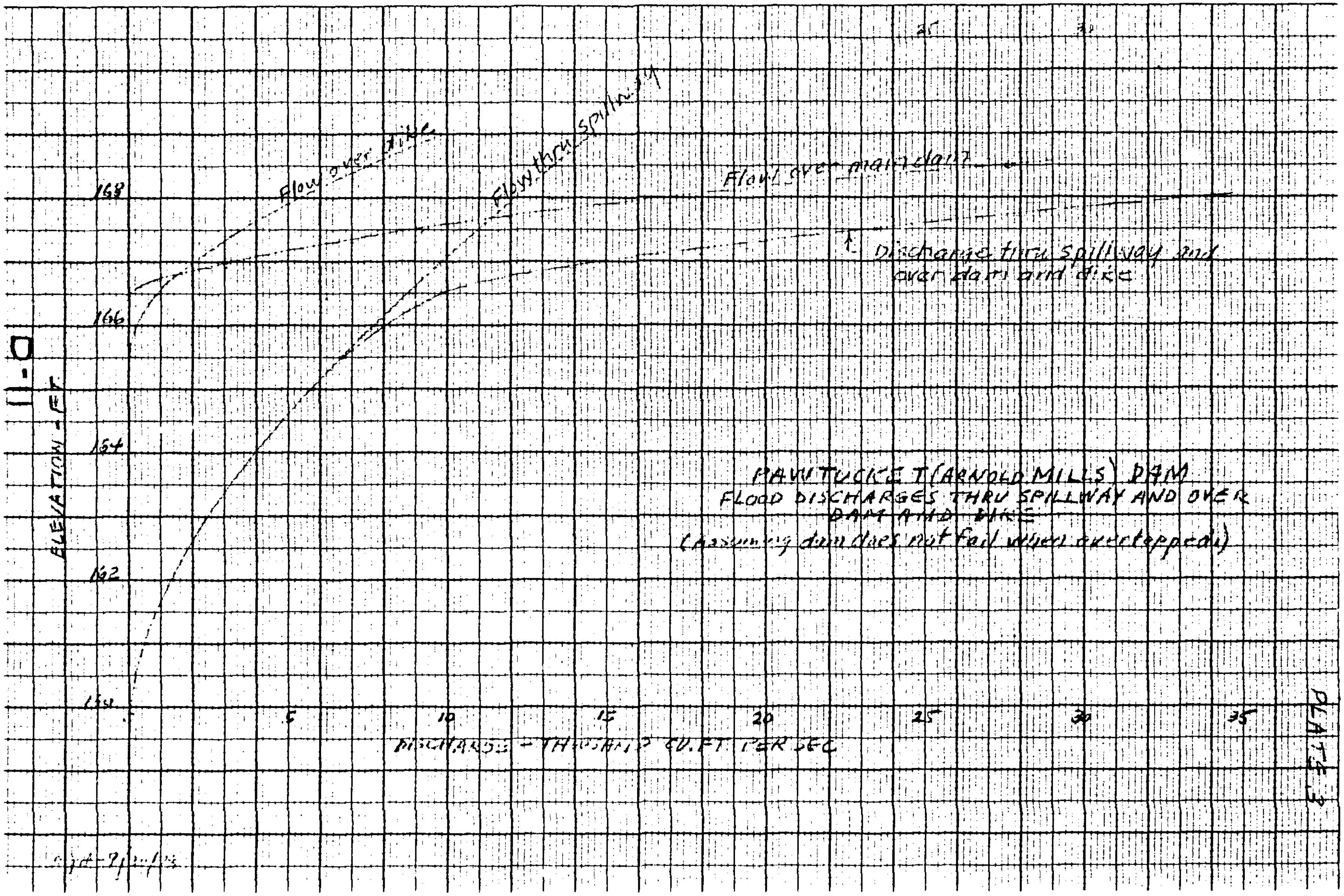
PAWTUCKET RESERVOIR (No 8)



D-0

KEUFFEL & ESSER CO
MADE IN U.S.A.

PLATE 3


PAWTUCKET (ARNOLD MILLS) DAM
FLOOD DISCHARGES THRU SPILLWAY AND OVER DAM AND DIKE
(Assuming dam does not fail when overtopped)
Flow over dike
Flow thru spillway
Flow over main dam
Discharge thru spillway and over dam and dike
ELEVATION - FT
168
166
164
162
5
10
15
20
25
30
35
DISCHARGE - THOUSAND CU. FT. PER SEC

BY CJH DATE 9-20-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO.____ OF ____

CHKD. BY ____ DATE ____ INSPECTION OF DAMS - CONN + R.I. PROJECT ____

SUBJECT PAWTUCKET (ARNOLD MILL DAM #8 - DISCHARGES THRU SPILLWAY AND OVER DAM + DIKE (Assuming dam does not fail when overtopped)

	Spillway					Dike - Center sect				Dike Abutment Section				Dam - Level Sect				Dam Sloping Sect				
Elev.	Head	Width	Ave Width	Coeff	Q	Head	Ave Width	Coeff	Q	Head	Ave Width	Coeff	Q	Head	Width	Coeff	Q	Ave Head	Width	Coeff	Q	ΣQ
160	0	150.8	–	–	0																	0
161	1.0	151.5	151.1	3.1	468																	468
162	2.0	152.7	151.8	3.15	1352																	1,352
163	3.0	152.8	152.5	3.2	2535																	2,535
164	4.0	153.5	153.2	3.26	3983																	3983
165	5.0	154.2	153.8	3.3	5774																	5,774
165.5	5.5	154.5	154.2	3.35	6663	0	241		0													6,663
166.0	6.0	154.9	154.5	3.4	7720	0.5	266	2.9	272													7,992
166.5	6.5	155.2	155.1	3.42	8939	1.0	291	2.95	858	0	258	–		0	2842	–	0	0	800	2.8	0	9,797
167														0.5		2.7	2715				376	
167.5	7.5	155.2	155.2	3.46	10,966	2.0	320	3.0	2715	1.0	264	2.9	766	1.0	2842	2.8	7958	0 to 1.0	800	2.8	1120	22247
168.5	8.5	155.2	155.2	3.46	13,307	3.0	330	3.05	5230	2.0	269	3.0	2333	2.0	2842	2.9	23311	1.0 to 2.0	800	2.9	4288	44,436
169.5	9.5	155.2	155.2	3.46	15,315	4.0	335	3.05	8174	3.0	275	3.05	4358	3.0				2.0 to 3.0				73,516
170.5	10.5	155.2	155.2	3.5	18,482	5.0	340	3.05	11594	4.0	281	3.05	6856	4.0				3.0 to 4.0				107,453

PLOTTED ON PLATE 3

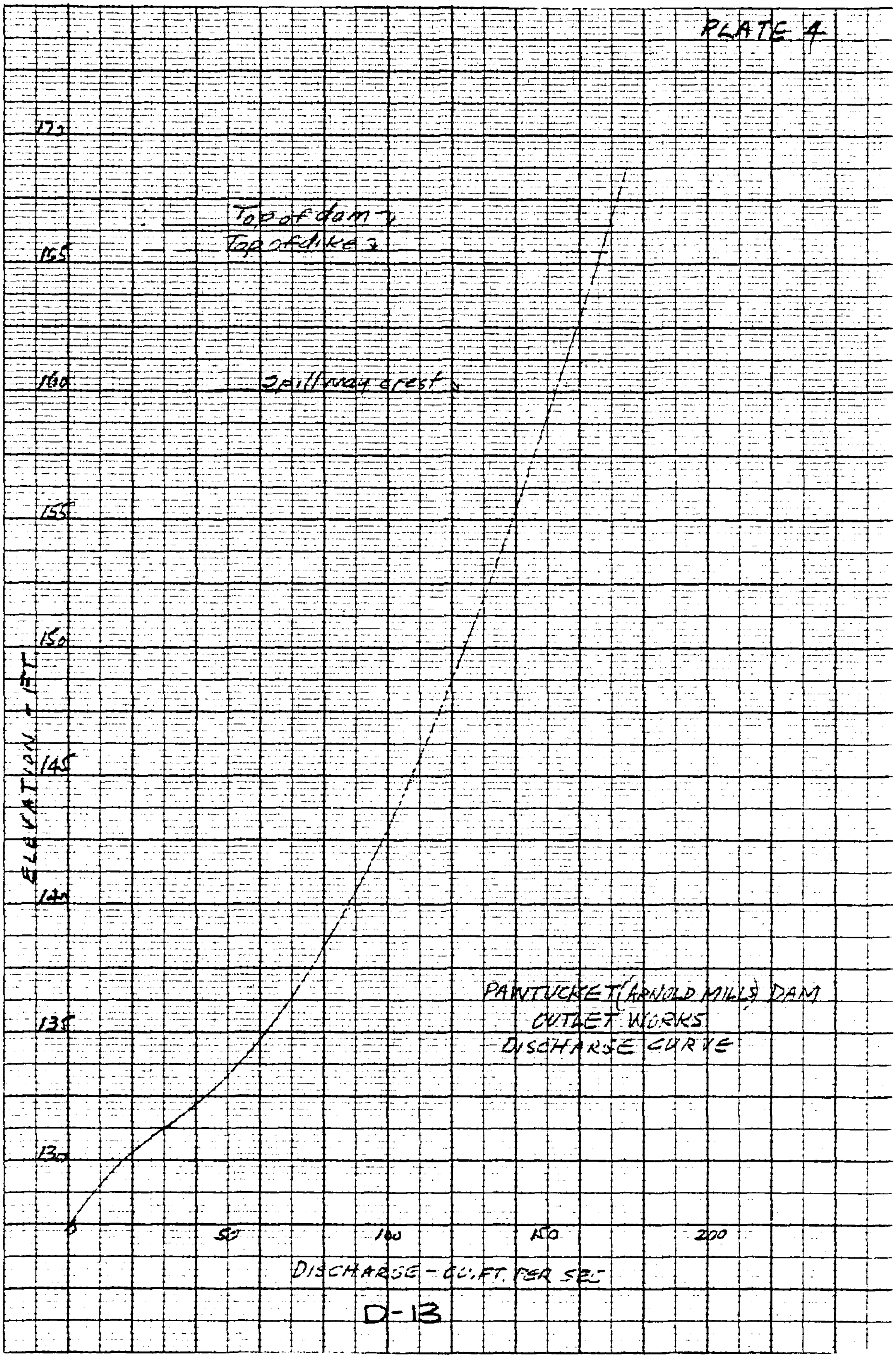


PLATE 4
170
Top of dam
Top of dike
165
160
Spillway crest
155
150
145
140
135
130
ELEVATION - FT.
0
50
100
150
200
DISCHARGE - CU. FT. PER SEC
PAWTUCKET (ARNOLD MILLS) DAM
OUTLET WORKS
DISCHARGE CURVE

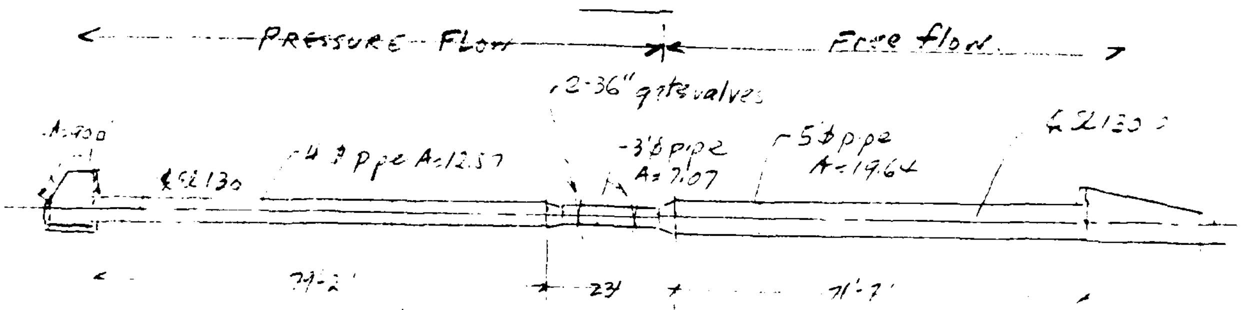
D-13

BY _____ DATE 11-22-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. _____ OF _____

CHKD. BY _____ DATE _____ INSPECTION OF DAMS - Conn & RI PROJECT _____

SUBJECT PAWTICKET - OUTLET WORKS DISCHARGE

OUTLET WORKS DISCHARGES.



Loss coeff. relative to 36" pipe A.

Item	Area sq ft	K	[illegible]	K
Trashrack	40	1.07	0.78	.09
Entrance	12.57	0.5	0.56	.28
Friction 4' ∅	12.57	.024 × [illegible]	0.56	.27
Contraction	-	0.2	+ 1.6 − .56	[illegible]
36" pipe	7.07	.03 × 23 / 3 = .23	1.0	.23
Valves × 2	7.07	0.2	1.0	.40
Exit	7.07	0.2	1.0	1.00
			K_T	2.[illegible]

Assuming free flow in 5' pipe

W.S. Elev	H	A	V	Q
128.5				0
132	2.0	7.07	5.57	39
135	5.0		8.80	62
[illegible]	10.0		12.44	88
145	15.0		15.24	108
150	20.0		17.60	124
155	25.0		19.67	139
160	30.0		21.55	152
165	35.0		23.28	165

Plotted on Plate 4

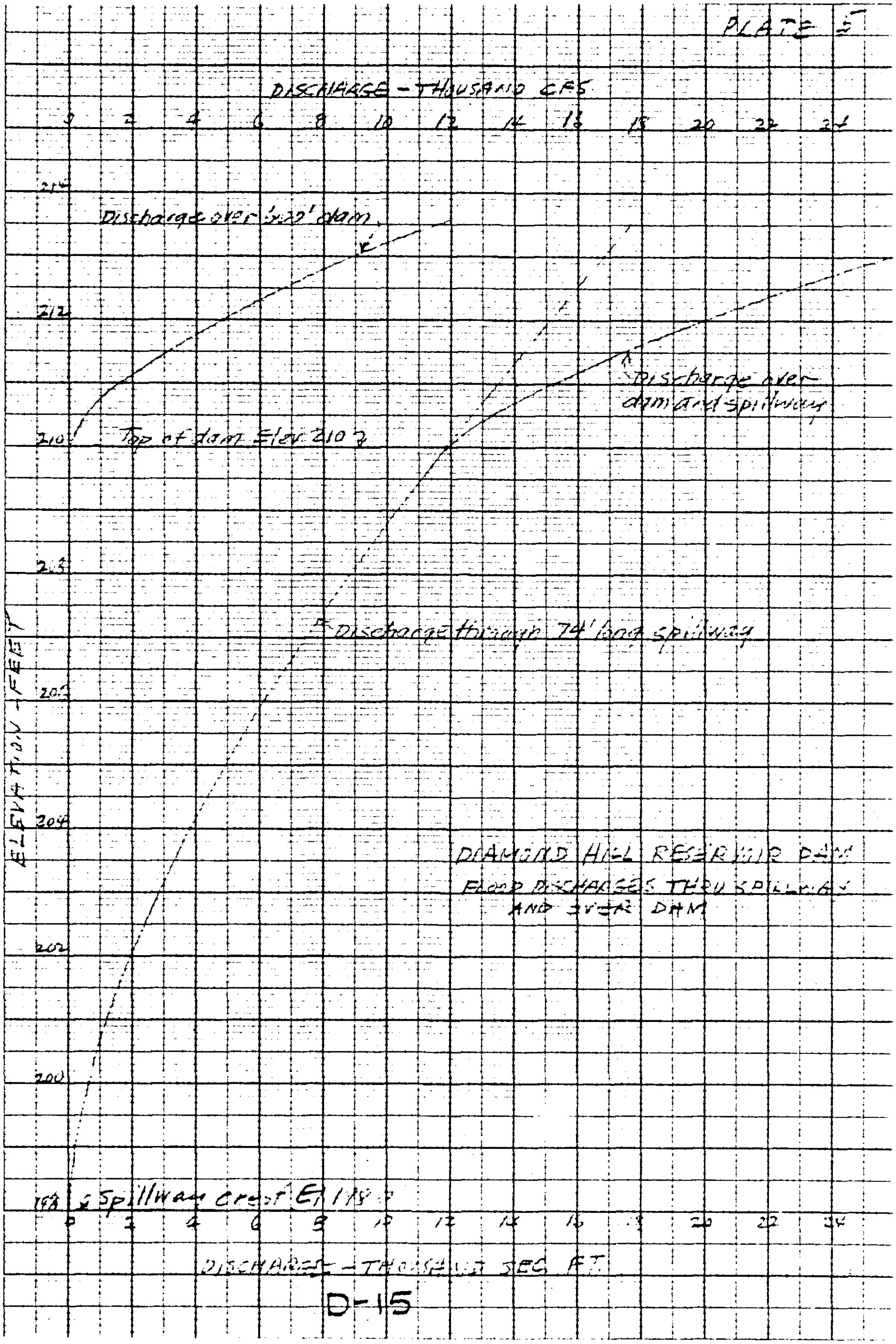


PLATE 5
DISCHARGE - THOUSAND CFS
Discharge over 320' dam
Top of dam Elev 210.2
Discharge over dam and spillway
Discharge through 74' long spillway
Spillway Crest El 198
DIAMOND HILL RESERVOIR DAM
FLOOD DISCHARGES THRU SPILLWAY AND OVER DAM
DISCHARGE - THOUSAND SEC FT
ELEV - NGVD

BY [illegible] DATE 10-9-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ______ DATE ______ INSPECTION OF DAMS - CONT. [illegible] PROJECT ______

SUBJECT [illegible] ARNOLD MILLS DAM.

D[illegible]D HILL DAM - S[illegible]LWAY DISCHARGE CURVE

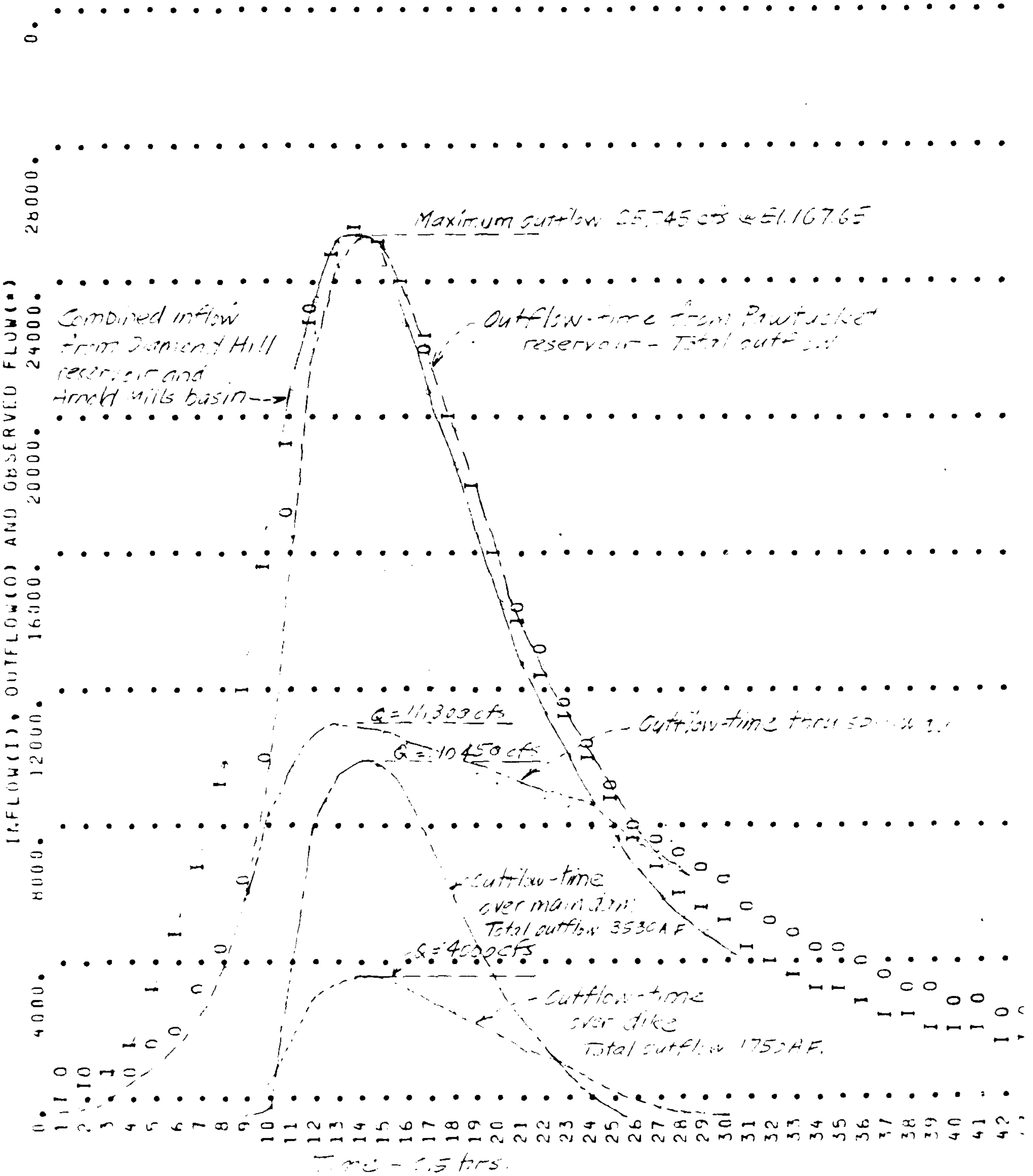
[illegible] L = 74' [illegible] crest [illegible] 7.5 H

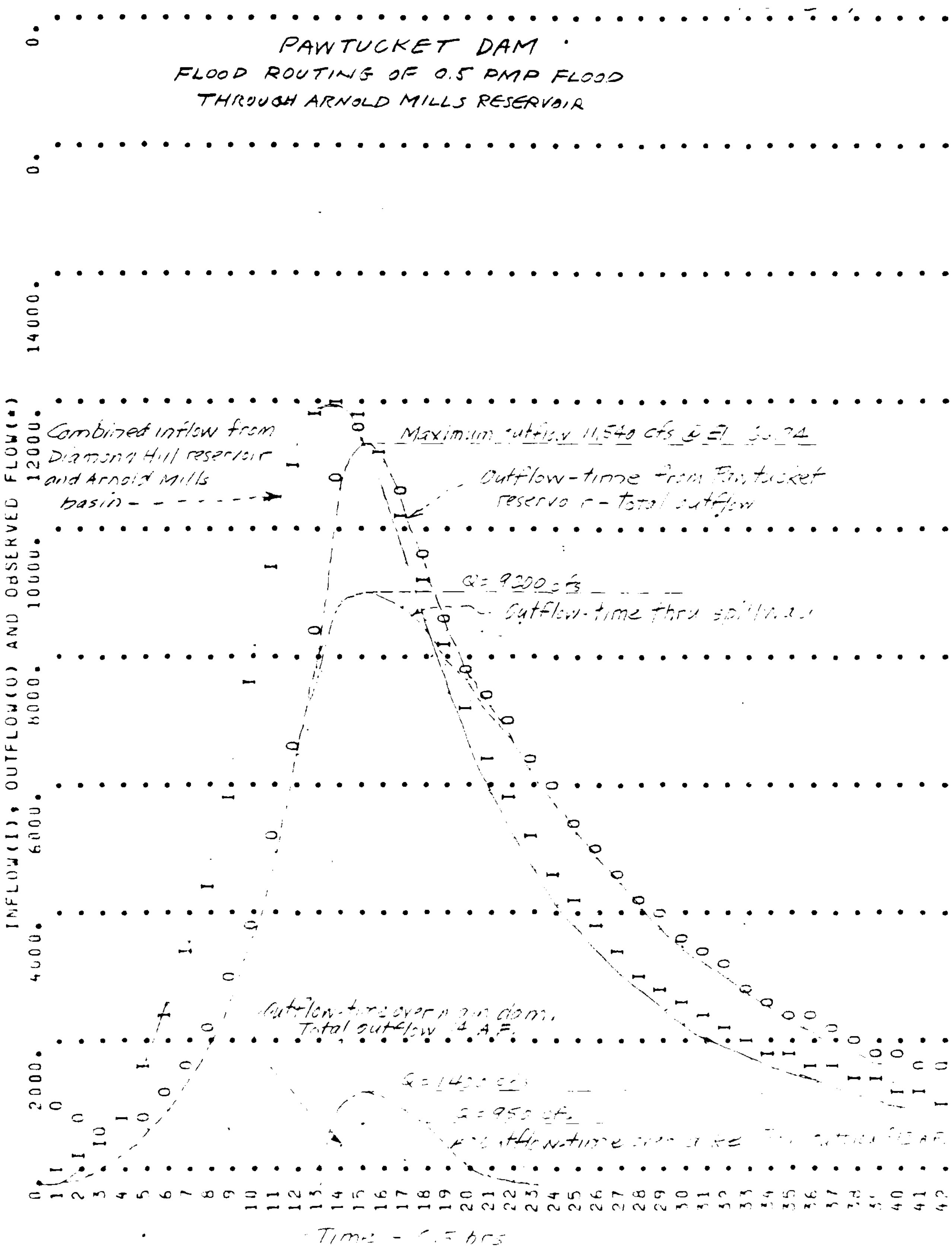
C = 3.6 [illegible] head

← SPILLWAY →						DAM - L = 600'			
Elev	H	$\frac{H}{H_o}$	$\frac{C}{C_o}$	C	Q	H	Coef.	Q	ΣQ
[illegible]	0	-		-					0
[illegible]	1	0.13	0.83	3.0	222				222
[illegible]	2	0.27	0.87	3.15	660				660
202	4	0.53	0.915	3.3	1954				1954
204	6	0.8	0.97	3.5	3806				3806
206	8	1.07	1.01	3.64	6095				6095
[illegible]	10	1.33	1.04	3.75	8775				8775
[illegible]	12	1.6	1.07	3.86	11874	0		0	11,874
[illegible]	13			3.9	13527	1	2.8	1680	15207
[illegible]	14			3.9	15118	2	2.85	4837	19955
213	15			3.9	16756	3	2.9	9041	25807
214	16			3.9	18470	4	2.9	13920	32390

PLOTTED ON PLATE 5

PAWTUCKET DAM
FLOOD ROUTING OF PMP FLOOD
THRU ARNOLD MILLS RESERVOIR

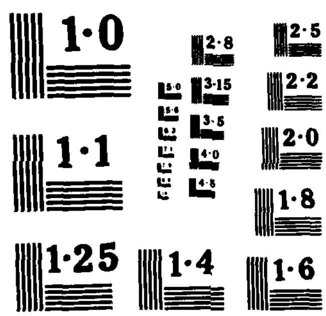



PAWTUCKET DAM
FLOOD ROUTING OF 0.5 PMP FLOOD
THROUGH ARNOLD MILLS RESERVOIR
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0.
0.
14000.
12000.
10000.
8000.
6000.
4000.
2000.
Combined inflow from Diamond Hill reservoir and Arnold Mills basin
Maximum outflow 11,540 cfs
Outflow-time from Pawtucket reservoir - Total outflow
Q = 9200 cfs
Outflow-time thru spillway
Total outflow
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42
Time

AD-A156 876 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS PAWTUCKETT RESERVOIR..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV NOV 78 2/2

UNCLASSIFIED F/G 13/13 NL

END
DATE
FILMED
8 85
DTIC


1·0
2·8
2·5
3·15
2·2
3·5
2·0
4·0
1·1
4·5
1·8
1·25
1·4
1·6

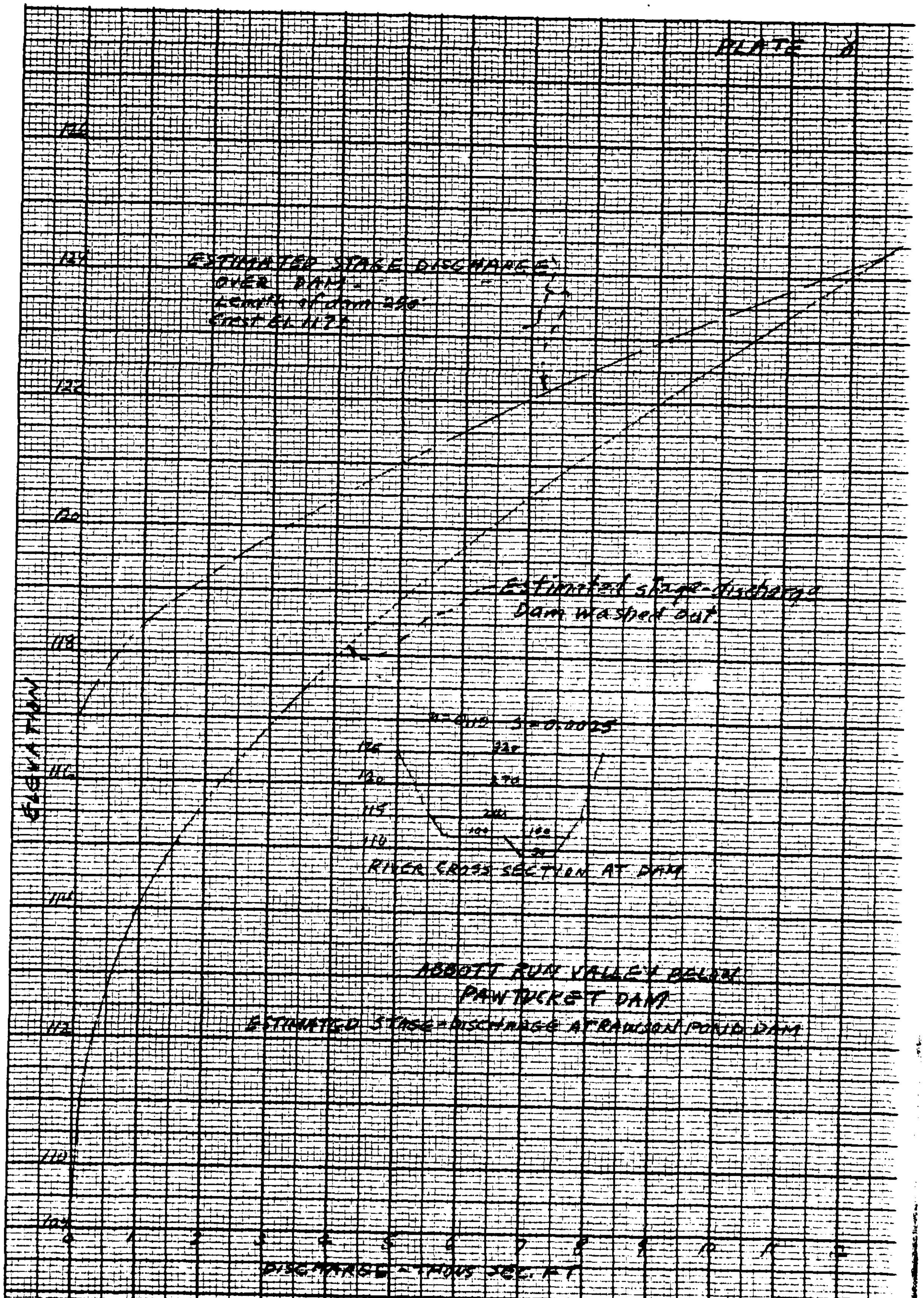


PLATE 8
ESTIMATED STAGE DISCHARGE OVER DAM -
Length of dam 250'
Crest EL 117.5
Estimated stage-discharge Dam washed out
n = 0.035 S = 0.0025
125
120
115
110
320
270
200
100
100
30
RIVER CROSS SECTION AT DAM
ABBOTT RUN VALLEY BELOW PAWTUCKET DAM
ESTIMATED STAGE-DISCHARGE AT RAWSON POND DAM
ELEVATION
126
124
122
120
118
116
114
112
110
108
0
1
2
3
4
5
6
7
8
9
10
11
12
DISCHARGE - THOUS SEC. FT

VALLEY STORAGE ABOVE RAWSON POND DAM

Elev.	Area Acres	Valley Storage AF
115	32	0
120	67	198
125		580
130	110	1083

At Rawson Dam.

Assume Dam crest @ El 117 (1 ft above pond level.)

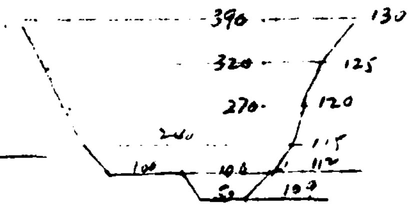
$L = \pm 250'$

Discharge over dam

Elev	H	C	Q
117	0		0
120	3	2.5	3250
125	8	2.5	14100

If dam washed out

Elev	Δ Area	Σ Area	W.P	r	$r^{2/3}$	$\frac{1.486}{n} A r^{2/3}$	$Q = \frac{1.49}{n} A r^{2/3} s^{1/2}$
109	-						
112	225	225	100.4	2.24	1.71	5,726	236
115	660	885	240.8	3.67	2.38	31,300	1565
120	1275	2160	272.4	7.93	3.98	127,637	6382
125	1475	3635	323.4	11.24	5.02	271,067	13,553
130	1775	5410	394.1	13.73	5.73	460,650	23,032



$S = \frac{20'}{8000'} = .0025$

```
*****************************
HEC-1 VERSION DATED JAN 1973
[illegible]D [illegible]74
CHANGE NO. 01
*****************************
                 PAWTUCKET DAM INSPECTION
                 RY 2
                 OCT 79

                               JOB SPECIFICATION
          NQ    NHR   NMIN   IDAY    IHR   IMIN METRC   IPLT   IPRT NSTAN
          70      0     30      0      0      0     0      0      0     0
                              JOPER     NWT
                                  3       0

**********         **********         **********         **********         **********

                            SUB-AREA RUNOFF COMPUTATION

          INFLOW HYDROGRAPH FOR DIAMOND HILL DAM
                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                            8       0       0       0       2       0       1

                                   HYDROGRAPH DATA
          IHYDG    IUHG    TAREA    SNAP    TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              2      -1     8.42     0.0     8.42     0.0     0.0       0       0       0

                                     PRECIP DATA
                            NP   STORM     DAJ      DAK
                            12     0.0     0.0      0.0
                                   PRECIP PATTERN
   0.92     0.92     1.11     1.12     1.31     1.50     2.08     5.19     1.31     1.31
   1.02     1.01

                                      LOSS DATA
      STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
        0.0     0.0    1.00     0.0     0.0    1.00     0.0     0.0     0.0     0.0

                             GIVEN UNIT GRAPH, NUHGQ=  33
    66.      237.     497.     840.    1133.    1271.    1256.    1115.     944.     748.
   590.      477.     382.     302.     244.     190.     149.     119.      96.      81.
    65.       49.      40.      37.      25.      21.      17.      13.      10.       8.
     6.        5.       5.
                UNIT GRAPH TOTALS  11042. CFS OR 1.02 INCHES OVER THE AREA

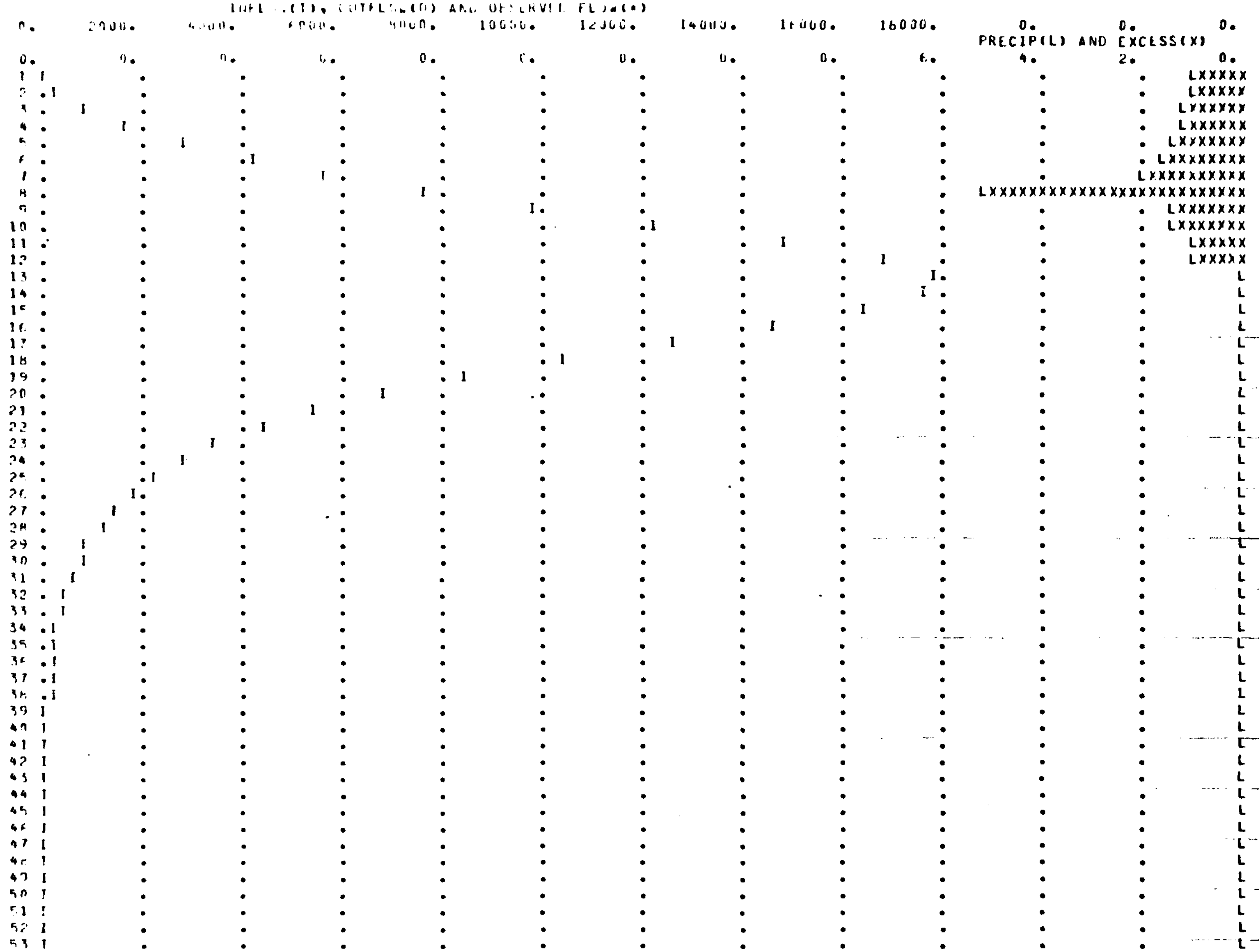
                                  RECESSION DATA
                    STRTQ=     0.0     QRCSN=     0.0     RTIOR= 1.00

                                END-OF-PERIOD FLOW
                           TIME   RAIN    EXCS     COMP Q
                              1   0.92    0.92        61.
                              2   0.92    0.92       279.
                              3   1.11    1.11       749.
                              4   1.12    1.12      1567.
                              5   1.31    1.31      2719.
                              6   1.50    1.50      4110.
                              7   2.08    2.08      5667.
                              8   5.19    5.19      7542.
```

10	1.31	1.31	12289.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
13	0.0	0.0	17739.
14	0.0	0.0	17568.
15	0.0	0.0	16428.
16	0.0	0.0	14683.
17	0.0	0.0	12521.
18	0.0	0.0	10407.
19	0.0	0.0	8468.
20	0.0	0.0	6809.
21	0.0	0.0	5418.
22	0.0	0.0	4328.
23	0.0	0.0	3432.
24	0.0	0.0	2731.
25	0.0	0.0	2178.
26	0.0	0.0	1748.
27	0.0	0.0	1411.
28	0.0	0.0	1130.
29	0.0	0.0	899.
30	0.0	0.0	729.
31	0.0	0.0	601.
32	0.0	0.0	463.
33	0.0	0.0	371.
34	0.0	0.0	294.
35	0.0	0.0	230.
36	0.0	0.0	173.
37	0.0	0.0	134.
38	0.0	0.0	100.
39	0.0	0.0	74.
40	0.0	0.0	48.
41	0.0	0.0	25.
42	0.0	0.0	15.
43	0.0	0.0	8.
44	0.0	0.0	3.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	17739.	13257.	4325.	2966.	207588.
INCHES		14.65	19.11	19.11	19.11
AC-FT		6577.	8582.	8582.	8582.

TATION


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. 16000. 16000.
PRECIP(L) AND EXCESS(X)
0. 0. 0.
0. 2. 4. 6.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

FLOOD ROUTING THROUGH UPPER RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
98	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

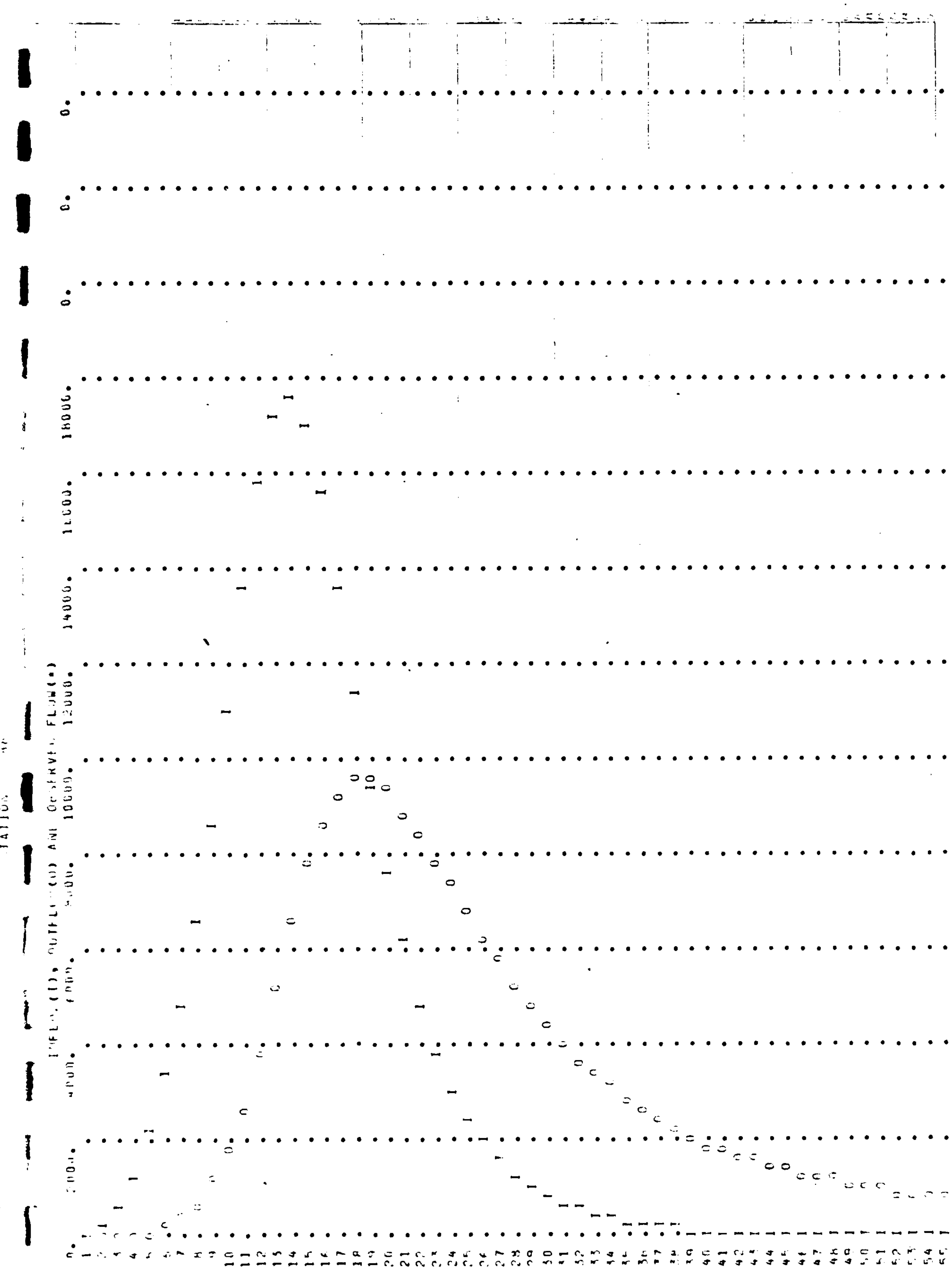
NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	[illegible]	793.	1612.	2457.	3328.	4225.	5148.	0.	0.	0.
OUTFLOW=	[illegible]	660.	1954.	3806.	6095.	8775.	11874.	0.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	3.	61.	0.
2	10.	170.	0.
3	31.	514.	0.
4	79.	1158.	0.
5	167.	2143.	0.
6	306.	3414.	126.
7	498.	4889.	337.
8	751.	6605.	614.
9	1074.	8674.	1104.
10	1472.	11048.	1733.
11	1941.	13560.	2676.
12	2461.	15817.	3816.
13	2988.	17271.	5202.
14	3475.	17653.	6535.
15	3882.	16998.	7751.
16	4186.	15556.	8659.
17	4377.	13602.	9287.
18	4462.	11464.	9569.
19	4456.	9438.	9552.
20	4383.	7639.	9304.
21	4259.	6114.	8890.
22	4103.	4873.	8411.
23	3927.	3880.	7884.
24	3740.	3082.	7326.
25	3550.	2455.	6759.
26	3364.	1963.	6201.
27	3185.	1580.	5713.
28	3009.	1271.	5256.
29	2842.	1015.	4819.
30	2685.	814.	4406.
31	2539.	665.	4021.
32	2402.	532.	3684.
33	2272.	417.	3401.
34	2151.	333.	3135.
35	2037.	262.	2887.
36	1931.	202.	2654.
37	1832.	154.	2437.
38	1741.	117.	2236.
39	1656.	87.	2050.

41	[illegible]	[illegible]	1761.
42	[illegible]	[illegible]	[illegible]
43	[illegible]	[illegible]	[illegible]
44	1403.	6.	1466.
45	1244.	2.	1373.
46	1150.	0.	1286.
47	1136.	0.	1205.
48	1090.	0.	1129.
49	1045.	0.	1058.
50	1002.	0.	991.
51	963.	0.	928.
52	926.	0.	869.
53	891.	0.	814.
54	858.	0.	763.
55	828.	0.	715.
56	799.	0.	670.
57	772.	0.	637.
58	746.	0.	609.
59	722.	0.	582.
60	698.	0.	556.
61	676.	0.	532.
62	654.	0.	508.
63	634.	0.	486.
64	614.	0.	464.
65	595.	0.	444.
66	577.	0.	424.
67	560.	0.	405.
68	544.	0.	387.
69	528.	0.	370.
70	513.	0.	354.
SUM			195372.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9569.	8327.	3907.	2791.	195372.
INCHES		9.20	17.27	17.99	17.99
AC-FT		4131.	7753.	8077.	8077.



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 **********          **********          **********          **********          **********

                              SUB-AREA RUNOFF COMPUTATION

             INFLOW HYDROGRAPH TO ARNOLD MILLS RESERVOIR NOT INCLUDED
                       ISTAG   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                         ARP       0       0       0       2       0       1

                                 HYDROGRAPH DATA
             IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                 0      -1    9.04    0.0     9.04    0.0     0.0       0       0       0

                                  PRECIP DATA
                               NP   STORM     DAJ     DAK
                               12    0.0      0.0     0.0
                                 PRECIP PATTERN
      0.92      0.92      1.11      1.12      1.31      1.50      2.08      5.19      1.31      1.31
      1.02      1.01

                                   LOSS DATA
      STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
        0.0     0.0    1.00     0.0     0.0    1.00     0.0     0.0     0.0     0.0

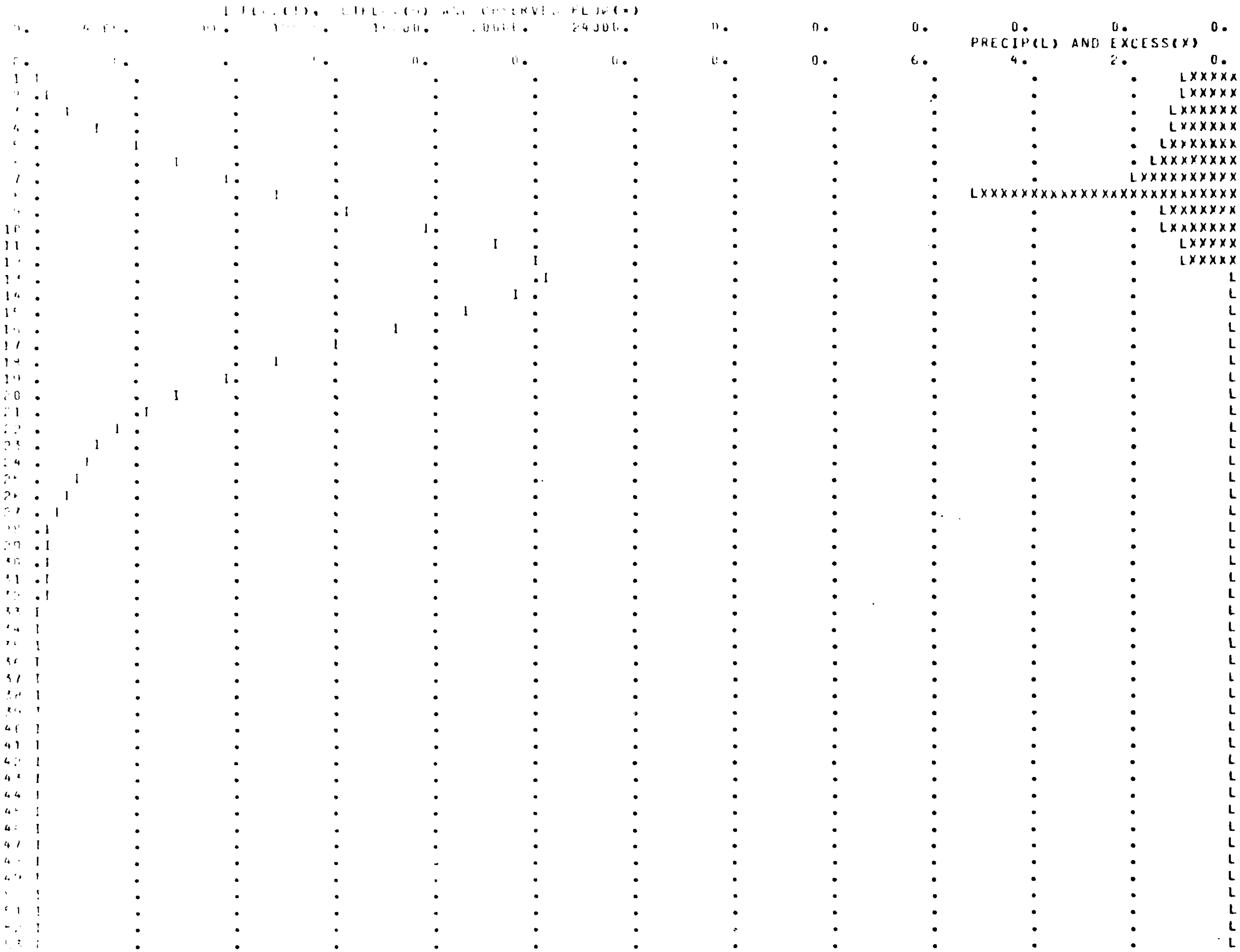
                             GIVEN UNIT GRAPH, NUHGG=  29
       98.      361.      749.     1242.     1498.     1535.     1370.     1140.      872.      676.
      529.      411.      322.      246.      185.      143.       92.       70.       53.       42.
       35.       25.       20.       16.       12.        9.        6.        5.        3.
            UNIT GRAPH TOTALS  11763. CFS OR 1.01 INCHES OVER THE AREA

                                 RECESSION DATA
                  STRTG=    0.0     QRCSN=    0.0      RTIOR= 1.00

                               END-OF-PERIOD FLOW
                            TIME    RAIN    EXCS      COMP Q
                               1    0.92    0.92         90.
                               2    0.92    0.92        422.
                               3    1.11    1.11       1130.
                               4    1.12    1.12       2342.
                               5    1.31    1.31       3885.
                               6    1.50    1.50       5628.
                               7    2.08    2.08       7453.
                               8    5.19    5.19       9701.
                               9    1.31    1.31      12476.
                              10    1.31    1.31      15554.
                              11    1.02    1.02      18566.
                              12    1.01    1.01      20183.
                              13    0.0     0.0       20405.
                              14    0.0     0.0       19243.
                              15    0.0     0.0       17240.
                              16    0.0     0.0       14566.
                              17    0.0     0.0       11928.
                              18    0.0     0.0        9495.
                              19    0.0     0.0        7409.
                              20    0.0     0.0        5717.
                              21    0.0     0.0        4385.
                              22    0.0     0.0        3344.
                              23    0.0     0.0        2541.
```

[illegible]	0.0	0.0	1401.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
28	0.0	0.0	597.
29	0.0	0.0	458.
30	0.0	0.0	354.
31	0.0	0.0	273.
32	0.0	0.0	206.
33	0.0	0.0	153.
34	0.0	0.0	110.
35	0.0	0.0	80.
36	0.0	0.0	51.
37	0.0	0.0	26.
38	0.0	0.0	15.
39	0.0	0.0	8.
40	0.0	0.0	3.
41	0.0	0.0	0.
42	0.0	0.0	0.
43	0.0	0.0	0.
44	0.0	0.0	0.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
SUM	18.80	18.80	221143.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20465.	14734.	4607.	3159.	221143.
INCHES		15.16	18.96	18.96	18.96
AC-FT		7310.	9143.	9143.	9143.


PRECIP(L) AND EXCESS(X)
24000.
6.
4.
2.
0.

HYDROGRAPH ROUTING

FLOOD ROUTING THROUGH UPPER RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
60	1	0	0	2	0	1

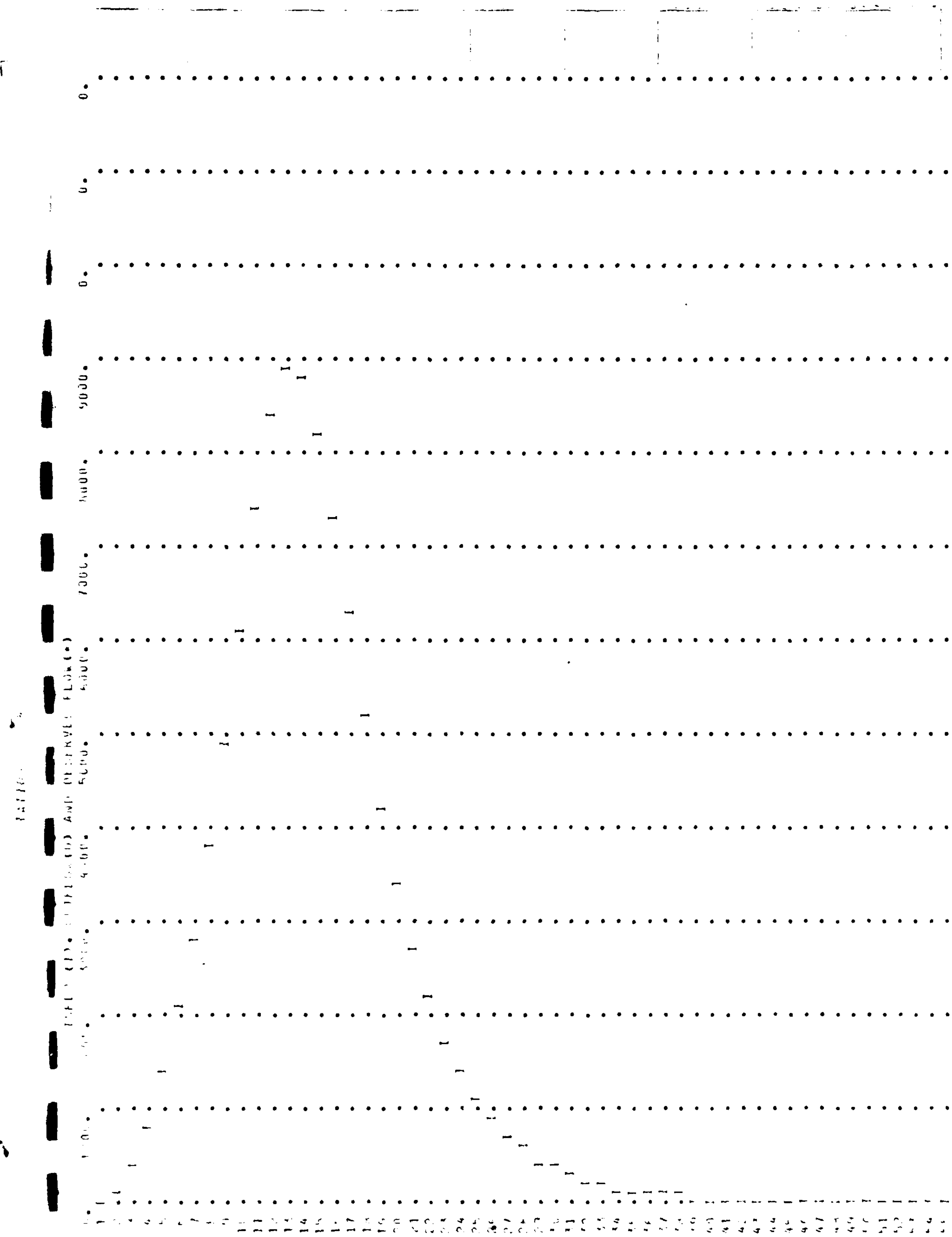
ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE	554.	797.	1612.	2457.	3328.	4225.	5148.	0.	0.	0.
OUTFLOW	222.	669.	1954.	3806.	6095.	8775.	11874.	0.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	1.	30.	0.
2	5.	85.	0.
3	15.	257.	0.
4	39.	579.	0.
5	84.	1071.	0.
6	154.	1707.	0.
7	254.	2444.	69.
8	384.	3302.	212.
9	551.	4337.	395.
10	758.	5524.	622.
11	1005.	6780.	995.
12	1282.	7909.	1432.
13	1570.	8635.	1887.
14	1845.	8827.	2464.
15	2083.	8499.	2987.
16	2273.	7778.	3402.
17	2407.	6801.	3697.
18	2487.	5732.	3886.
19	2520.	4719.	3971.
20	2514.	3819.	3956.
21	2479.	3057.	3863.
22	2423.	2436.	3730.
23	2352.	1940.	3575.
24	2271.	1541.	3399.
25	2185.	1227.	3211.
26	2097.	982.	3018.
27	2009.	790.	2525.
28	1923.	635.	2635.
29	1839.	507.	2451.
30	1758.	407.	2274.
31	1681.	332.	2105.
32	1608.	266.	1948.
33	1539.	209.	1838.
34	1472.	165.	1732.
35	1408.	131.	1631.
36	1346.	101.	1534.
37	1288.	77.	1442.
38	1233.	59.	1355.
39	1180.	45.	1272.

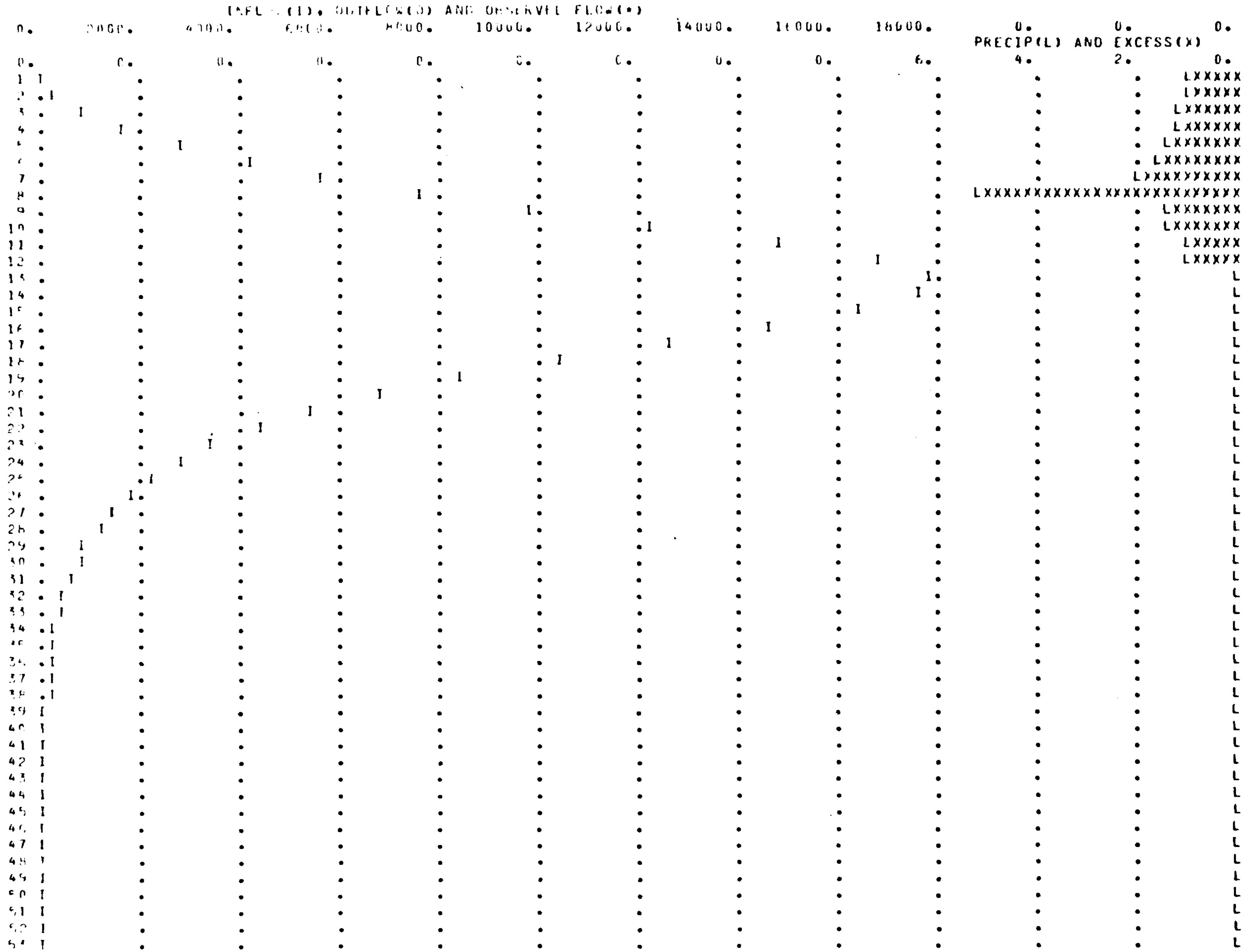


[illegible] FF [illegible] IPL[illegible] Y 0 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7055.	[illegible]	[illegible]	4903.	61[illegible].
[illegible]	[illegible]	[illegible]	6784.	8214.	7342.	6260.	5204.	4234.	3405.
[illegible]	[illegible]	171[illegible].	1566.	1069.	874.	706.	565.	449.	364.
801.	[illegible]31.	1[illegible].	147.	11[illegible].	87.	67.	50.	37.	24.
1[illegible].	[illegible].	[illegible].	2.	0.	0.	0.	0.	0.	0.
[illegible].	0.	[illegible].	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8869.	6629.	2162.	1483.	103794.
INCHES		7.52	9.56	9.56	9.5[illegible]
AC-FT		4289.	4291.	4291.	4291.

TATION


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 2000. 4000. 6000. 8000. 10000. 12000. 14000. 16000. 18000.
PRECIP(L) AND EXCESS(X)
6. 4. 2. 0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	17775.	17257.	4325.	2966.	207588.
INCHES		14.65	19.11	19.11	19.11
AC-FT		6577.	8582.	8582.	8582.

10	1.[illegible]	1.[illegible]	12[illegible].
[illegible]	1.[illegible]	1.[illegible]	14[illegible]
[illegible]	1.[illegible]	1.[illegible]	1[illegible].
13	0.0	0.0	17739.
14	0.0	0.0	17568.
15	0.0	0.0	16428.
16	0.0	0.0	14683.
17	0.0	0.0	12521.
18	0.0	0.0	10407.
19	0.0	0.0	8468.
20	0.0	0.0	6609.
21	0.0	0.0	5418.
22	0.0	0.0	4328.
23	0.0	0.0	3432.
24	0.0	0.0	2731.
25	0.0	0.0	2178.
26	0.0	0.0	1748.
27	0.0	0.0	1411.
28	0.0	0.0	1130.
29	0.0	0.0	899.
30	0.0	0.0	729.
31	0.0	0.0	601.
32	0.0	0.0	463.
33	0.0	0.0	371.
34	0.0	0.0	294.
35	0.0	0.0	230.
36	0.0	0.0	173.
37	0.0	0.0	134.
38	0.0	0.0	100.
39	0.0	0.0	74.
40	0.0	0.0	48.
41	0.0	0.0	25.
42	0.0	0.0	15.
43	0.0	0.0	8.
44	0.0	0.0	3.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.

```
******************************
HEC-1 VERSION DATED [illegible]
[illegible]
CHANGE [illegible] 11
******************************
        [illegible]TUCKET DAM INSPECTION
        RV 2
        OCT 7[illegible]

                         JOB SPECIFICATION
     NQ   NHR  NMIN  IDAY   IHR  IMIN METRC  IPLT  IPRT NSTAN
     70     0    30     0     0     0     0     0     0     0
                      JOPER   NWT
                          4     0

**********     **********     **********     **********     **********

                      SUB-AREA RUNOFF COMPUTATION

   INFLOW HYDROGRAPH FOR DIAMOND HILL DAM
          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
            F       0       0       0       2       0       1

                           HYDROGRAPH DATA
  IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO  ISNOW  ISAME  LOCAL
     [illegible]     -1    [illegible]     0.0    8.42    0.0   0.500      0      0      0

                            PRECIP DATA
                      NP   STORM     DAJ     DAK
                      12    0.0      0.0     0.0
                            PRECIP PATTERN
  0.[illegible]   0.9[illegible]   1.11   1.12   1.31   1.50   2.08   5.19   1.31   1.31
  1.0[illegible]   1.01

                             LOSS DATA
  STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
   0.0    0.0   1.00    0.0    0.0   1.00    0.0    0.0    0.0    0.0

                     GIVEN UNIT GRAPH, NUHGQ=  35
    [illegible]    [illegible]7.    497.    840.   1173.   1271.   1256.   1115.    944.    748.
   591.    477.    [illegible]2.    302.    244.    190.    149.    119.     96.     81.
    [illegible]     49.     4[illegible].     37.     25.     21.     17.     13.     10.      6.
     [illegible]      5.      [illegible].
      UNIT GRAPH TOTALS  11042. CFS OR 1.02 INCHES OVER THE AREA

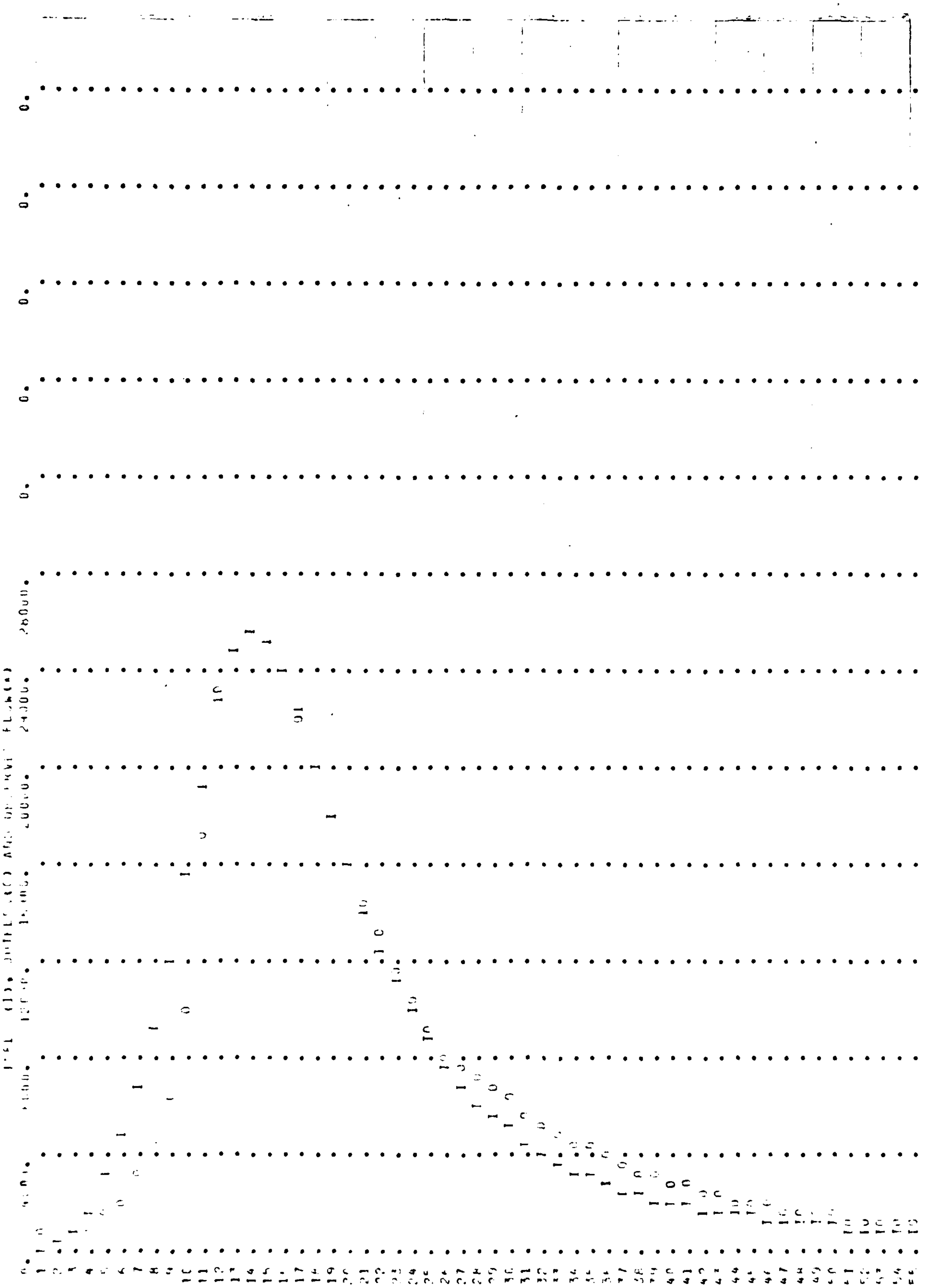
                          RECESSION DATA
           STRTQ=    0.0    QRCSN=    0.0     RTIOR= 1.00

                        END-OF-PERIOD FLOW
                    TIME   RAIN   EXCS    COMP Q
                      1    0.92   0.92      61.
                      2    0.92   0.92     279.
                      3    1.11   1.11     749.
                      4    1.12   1.12    1567.
                      5    1.31   1.31    2719.
                      6    1.50   1.50    4110.
                      7    2.08   2.08    5667.
                      8    5.19   5.19    7542.
```

.5 PMF

[illegible] Y, [illegible]AGE [illegible]

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	B	17755.	13257.	4325.	2966.	8.42
ROUTED TO	BB	[illegible]569.	8527.	3907.	2791.	8.42
HYDROGRAPH AT	BBB	20405.	14734.	4607.	3159.	9.04
2 COMBINED	BCBB	25778.	20664.	8427.	5950.	17.46
ROUTED TO	BBBBB	25745.	20287.	6386.	5986.	17.46



41	285.	1341.	[illegible]1.
42	[illegible]	[illegible]	[illegible]7.
43	2[illegible].	[illegible].	[illegible]10.
44	187.	1515.	2148.
45	170.	1423.	2060.
46	156.	1333.	1865.
47	113.	1245.	1738.
48	91.	1167.	1621.
49	72.	1095.	1514.
50	54.	1024.	1414.
51	37.	953.	1322.
52	21.	893.	1236.
53	6.	843.	1155.
54	-7.	788.	1081.
55	-20.	739.	1011.
56	-32.	692.	946.
57	-43.	655.	887.
58	-52.	623.	833.
59	-61.	595.	785.
60	-69.	563.	741.
61	-76.	544.	701.
62	-83.	520.	664.
63	-89.	497.	630.
64	-95.	475.	598.
65	-100.	454.	569.
66	-105.	434.	541.
67	-110.	415.	516.
68	-115.	395.	491.
69	-119.	379.	468.
70	-123.	362.	447.
SUM			419018.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25745.	20267.	8386.	5986.	419018.
INCHES		10.81	17.87	18.60	18.60
AC-FT		10065.	16642.	17324.	17324.

HYDROGRAPH ROUTING

[illegible] THROUGH [illegible] ILL DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
[illegible]	1	0	0	2	0	1

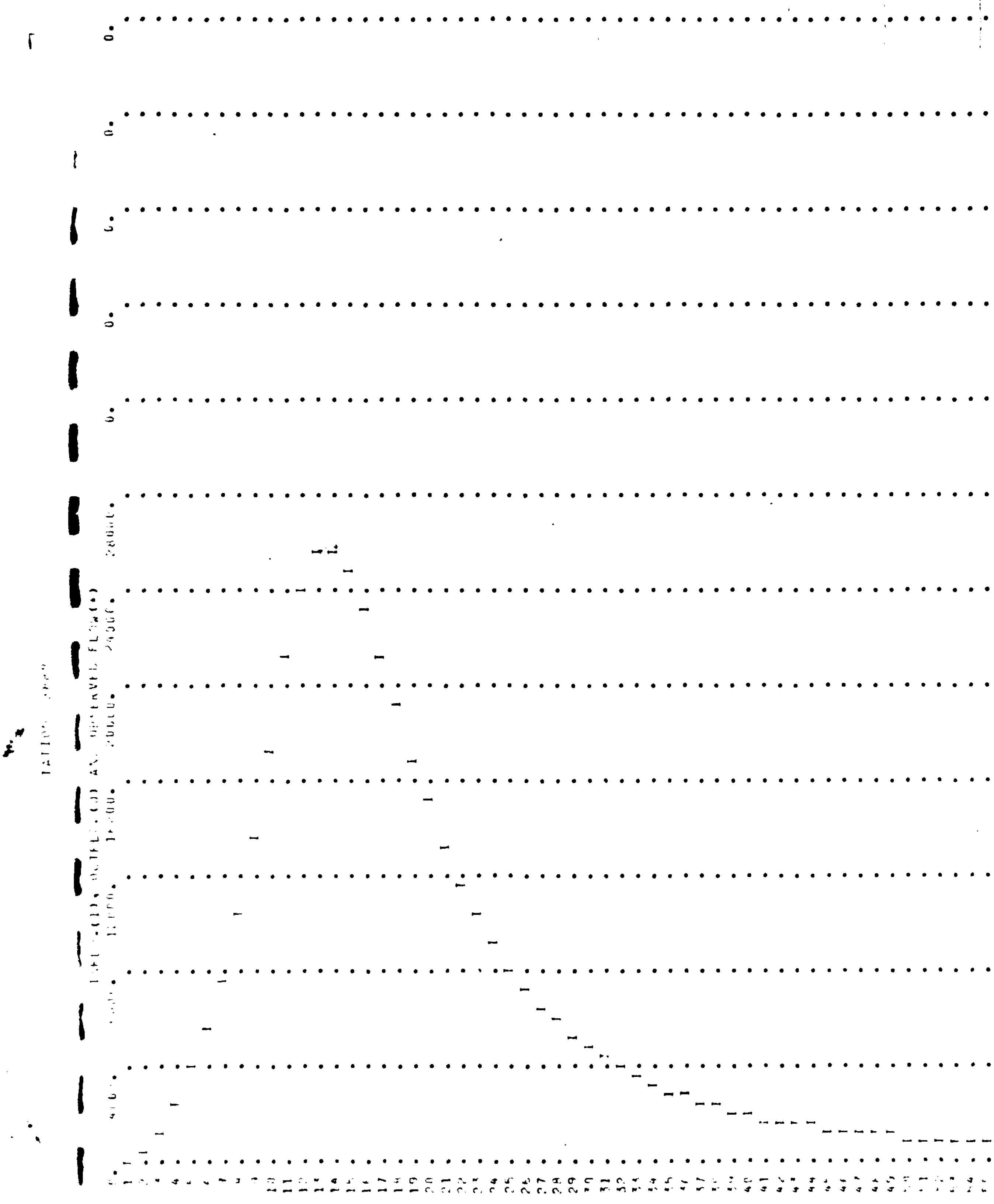
ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
[illegible]	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	[illegible]	522.	792.	1068.	1350.	1638.	1932.	2232.	0.	0.
OUTFLOW=	[illegible]	7983.	5774.	7992.	15000.	31000.	57500.	90000.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	-38.	90.	910.
2	-62.	256.	777.
3	-63.	776.	777.
4	-27.	1736.	972.
5	53.	3114.	1408.
6	179.	4819.	2103.
7	352.	6772.	3053.
8	574.	9053.	4328.
9	849.	11948.	6236.
10	1151.	15434.	10049.
11	1387.	19265.	17051.
12	1494.	22621.	23004.
13	1529.	24803.	24927.
14	1543.	25692.	25745.
15	1536.	25384.	25359.
16	1512.	24108.	24022.
17	1478.	22220.	22096.
18	1440.	20137.	20005.
19	1402.	18013.	17876.
20	1366.	15991.	15862.
21	1325.	14148.	14385.
22	1274.	12515.	13116.
23	1219.	11090.	11742.
24	1166.	9806.	10428.
25	1118.	8673.	9238.
26	1076.	7705.	8198.
27	1032.	6879.	7703.
28	978.	6180.	7269.
29	918.	5565.	6784.
30	855.	5019.	6281.
31	795.	4527.	5782.
32	732.	4092.	5373.
33	672.	3722.	4975.
34	614.	3400.	4595.
35	560.	3106.	4236.
36	509.	2836.	3912.
37	460.	2584.	3642.
38	412.	2357.	3380.
39	367.	2155.	3131.



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COMBINE HYDROGRAPHS

COMBINATION OF DISCHARGE FROM UPPER RESERVOIR & LOWER I

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
8888	2	0	0	2	0	1

SUM OF 2 HYDROGRAPHS AT 8888

90.	422.	1130.	2342.	3885.	5754.	7790.	10315.	13581.	17267.
21242.	23999.	25607.	25778.	24991.	23225.	21214.	19064.	16961.	15021.
13275.	11755.	10425.	9187.	8160.	7251.	6506.	5852.	5277.	4760.
4294.	3890.	3554.	3246.	2967.	2705.	2463.	2251.	2058.	1901.
1781.	1669.	1564.	1466.	1373.	1286.	1205.	1129.	1058.	991.
928.	869.	814.	763.	715.	670.	637.	609.	582.	556.
532.	508.	486.	464.	444.	424.	405.	387.	370.	354.

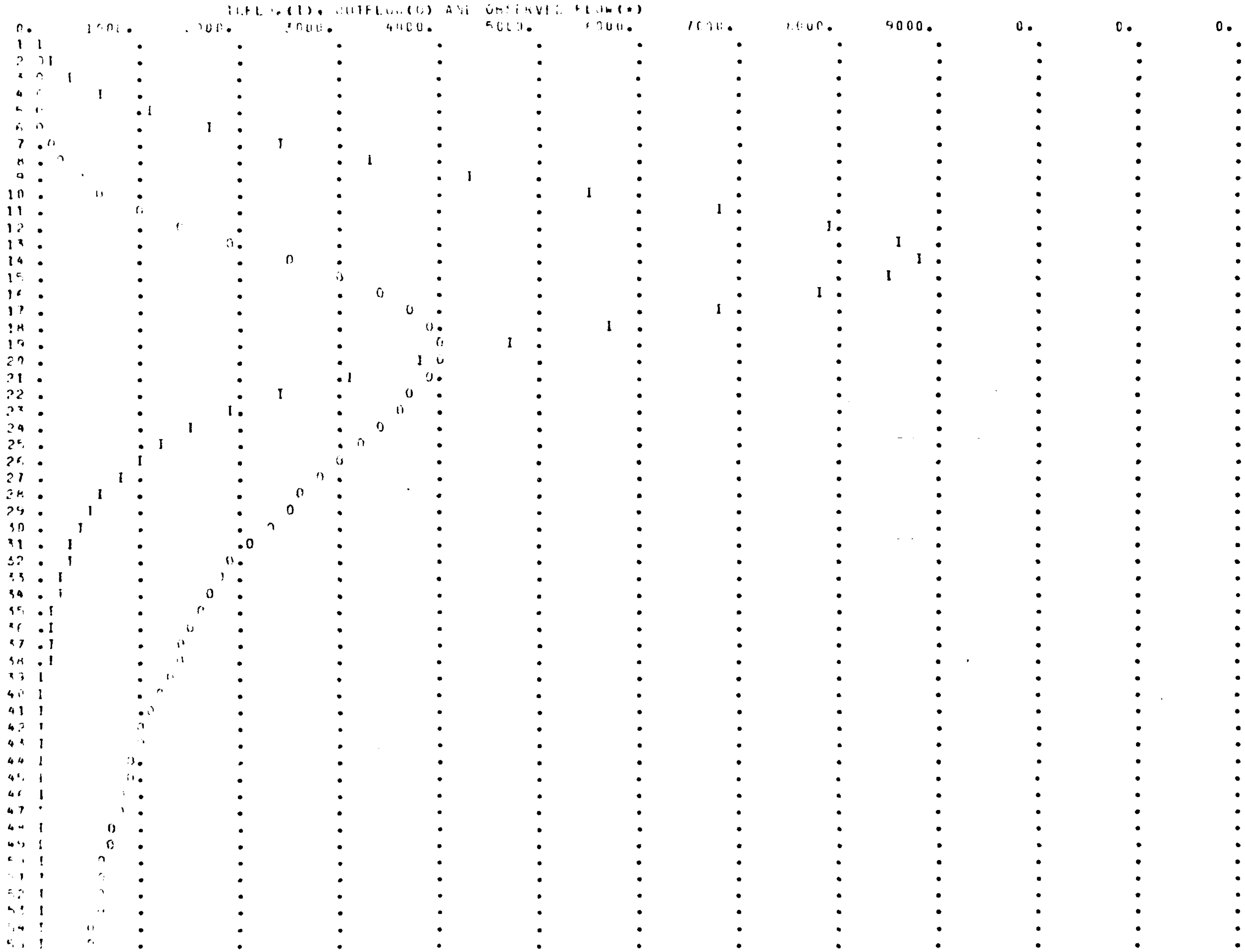
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25778.	20664.	8427.	5950.	416516.
INCHES		11.01	17.56	18.49	18.49
AC-FT		10252.	16723.	17220.	17220.

41	[illegible]	[illegible]	1119.
42	[illegible]	[illegible]	[illegible]
43	[illegible]	[illegible]	[illegible]
44	958.	5.	921.
45	921.	1.	863.
46	887.	0.	808.
47	855.	0.	757.
48	824.	0.	709.
49	796.	0.	664.
50	769.	0.	634.
51	743.	0.	606.
52	719.	0.	579.
53	696.	0.	553.
54	673.	0.	529.
55	652.	0.	505.
56	631.	0.	483.
57	612.	0.	462.
58	593.	0.	441.
59	575.	0.	422.
60	558.	0.	403.
61	542.	0.	385.
62	526.	0.	368.
63	512.	0.	352.
64	497.	0.	336.
65	484.	0.	321.
66	471.	0.	307.
67	458.	0.	294.
68	447.	0.	281.
69	435.	0.	268.
70	424.	0.	256.

SUM 93667.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3971.	3556.	1845.	1338.	93667.
INCHES		3.93	8.15	8.62	8.62
AC-FT		1765.	3661.	3873.	3873.

STATION


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0.
1000.
2000.
3000.
4000.
5000.
6000.
7000.
8000.
9000.
0.
0.
0.

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO ARNOLD MILLS RESERVOIR NOT INCLUDED

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
AMR	0	0	0	2	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	9.04	0.0	9.04	0.0	0.500	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
12	0.0	0.0	0.0

PRECIP PATTERN

0.92	0.92	1.11	1.12	1.31	1.50	2.08	5.19	1.31	1.31
1.02	1.01								

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.0	0.0	0.0	0.0

GIVEN UNIT GRAPH, NUHGQ= 29

[illegible]	361.	749.	1242.	1498.	1535.	1370.	1140.	872.	676.
52[illegible].	411.	322.	246.	185.	143.	92.	70.	53.	42.
3[illegible].	25.	20.	16.	12.	9.	6.	5.	3.	

UNIT GRAPH TOTALS 11763. CFS OR 1.01 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

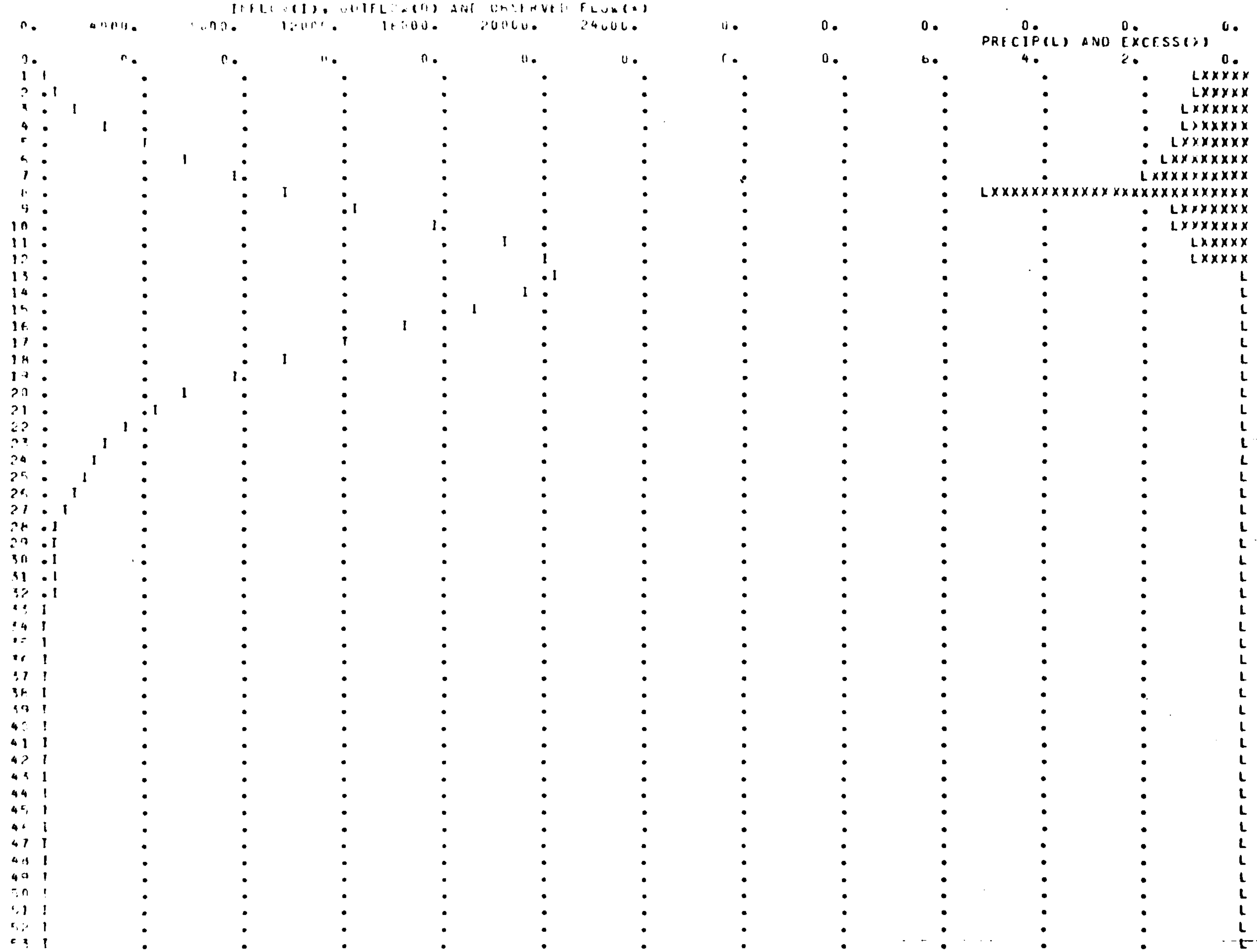
END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.92	0.92	90.
2	0.92	0.92	422.
3	1.11	1.11	1130.
4	1.12	1.12	2342.
5	1.31	1.31	3885.
6	1.50	1.50	5624.
7	2.08	2.08	7453.
8	5.19	5.19	9701.
9	1.31	1.31	12476.
10	1.31	1.31	15554.
11	1.02	1.02	18566.
12	1.01	1.01	20183.
13	0.0	0.0	20405.
14	0.0	0.0	19243.
15	0.0	0.0	17240.
16	0.0	0.0	14566.
17	0.0	0.0	11928.
18	0.0	0.0	9495.
19	0.0	0.0	7409.
20	0.0	0.0	5717.
21	0.0	0.0	4365.
22	0.0	0.0	3344.
23	0.0	0.0	2541.

[illegible]	0.0	0.0	1401.
[illegible]	0.0	0.0	11[illegible]
[illegible]	0.0	0.0	[illegible]
28	0.0	0.0	597.
29	0.0	0.0	458.
30	0.0	0.0	354.
31	0.0	0.0	273.
32	0.0	0.0	206.
33	0.0	0.0	153.
34	0.0	0.0	110.
35	0.0	0.0	80.
36	0.0	0.0	51.
37	0.0	0.0	26.
38	0.0	0.0	15.
39	0.0	0.0	8.
40	0.0	0.0	3.
41	0.0	0.0	0.
42	0.0	0.0	0.
43	0.0	0.0	0.
44	0.0	0.0	0.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
SUM	18.80	18.80	221143.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10405.	14734.	4607.	3159.	221143.
INCHES		15.16	18.96	18.96	18.96
AC-FT		7510.	9143.	9143.	9143.

STATION


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0.
4000.
12000.
16000.
20000.
24000.
PRECIP(L) AND EXCESS(X)
6.
4.
2.
0.

RUNOFF MULTIPLIED BY 0.50

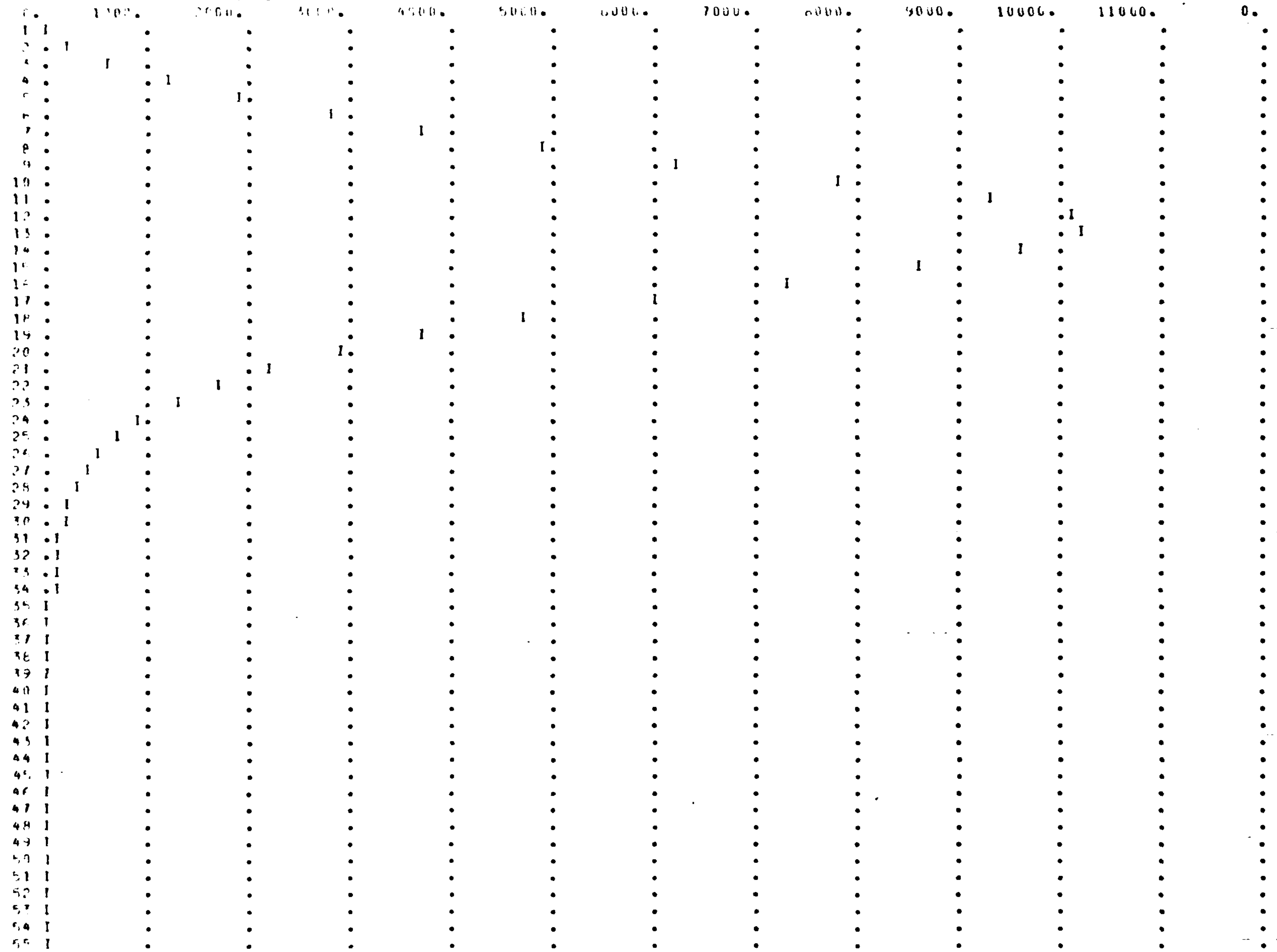
4[illegible].	[illegible]11.	[illegible]	1[illegible]7[illegible]	1[illegible]	2814.	5[illegible]	[illegible]0.	238[illegible]	7[illegible]
[illegible]	[illegible]2.	[illegible]	[illegible]	[illegible]0.	7285.	5584.	4747.	3705.	2659.
[illegible]19[illegible].	1[illegible]72.	1[illegible]71.	[illegible]41.	700.	525.	397.	298.	229.	177.
137.	10[illegible].	77.	55.	40.	26.	15.	8.	4.	2.
[illegible].	0.	[illegible].	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
[illegible].	0.	[illegible].	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10203.	7367.	2304.	1580.	110571.
INCHES		7.[illegible]	9.48	9.46	9.47
AC-FT		365[illegible].	4571.	4571.	4571.

D-50

STATION [illegible]

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)



COMBINE HYDROGRAPHS

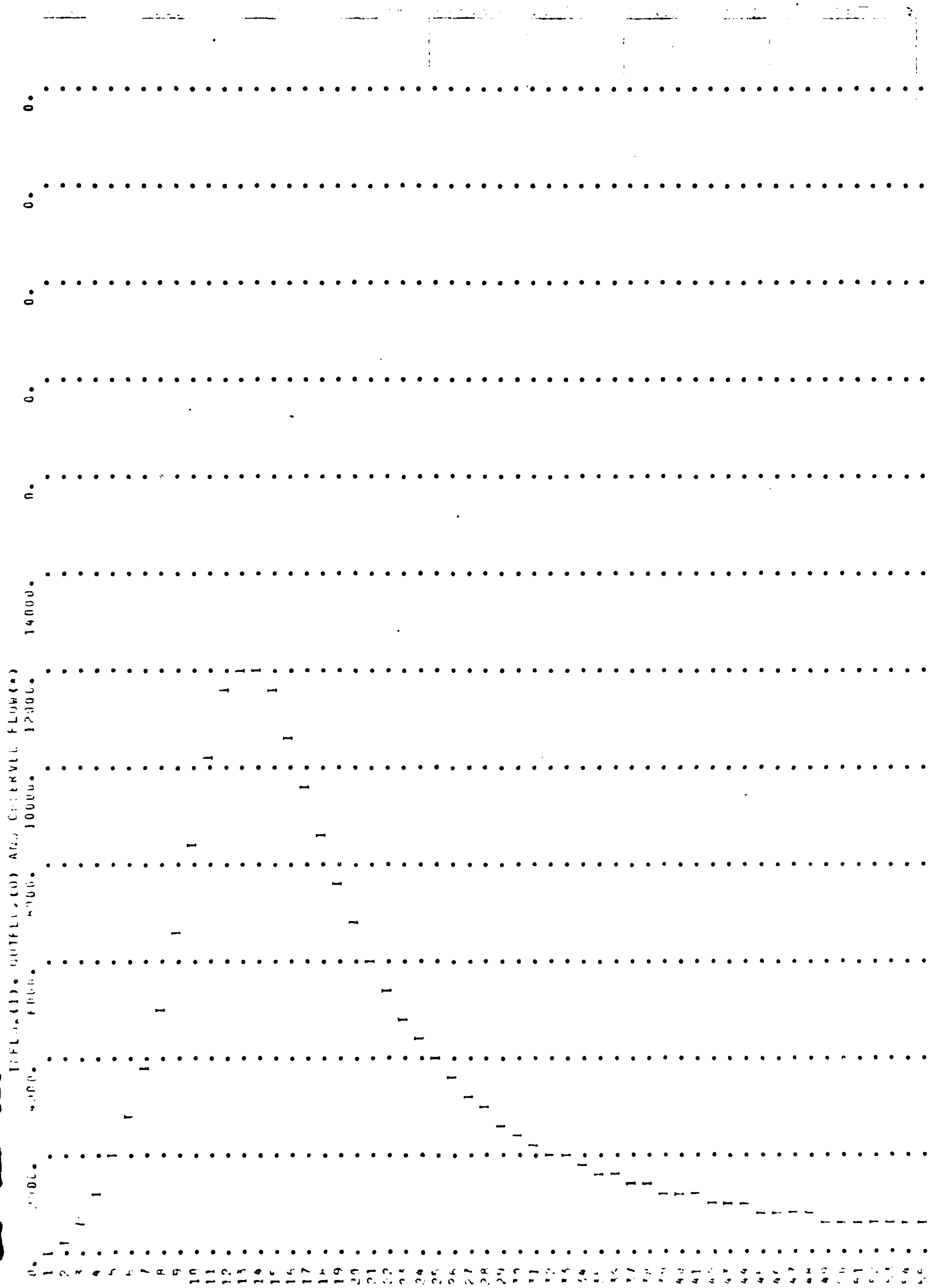
COMBINATION OF DISCHARGE FROM UPPER RESERVOIR & LOWER 1

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
8888	2	0	0	2	0	1

SUM OF 2 HYDROGRAPHS AT 8888

45.	211.	565.	1171.	1542.	2814.	3796.	5063.	6633.	8399.
10276.	11524.	12090.	12085.	11667.	10665.	9660.	8633.	7676.	6814.
6056.	5403.	4846.	4330.	3911.	3542.	3222.	2933.	2680.	2451.
2243.	2051.	1915.	1788.	1671.	1560.	1455.	1362.	1276.	1195.
1119.	1049.	983.	921.	863.	808.	757.	709.	664.	634.
606.	579.	553.	529.	505.	483.	462.	441.	422.	403.
385.	368.	352.	336.	321.	307.	294.	281.	268.	256.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12090.	9674.	4081.	2918.	204238.
INCHES		5.15	8.70	9.07	9.07
AC-FT		4799.	8098.	8444.	8444.


14000.
12000.
10000.

HYDROGRAPH ROUTING

ROUTING THROUGH ARNOLD MILL DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
ERRAR	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

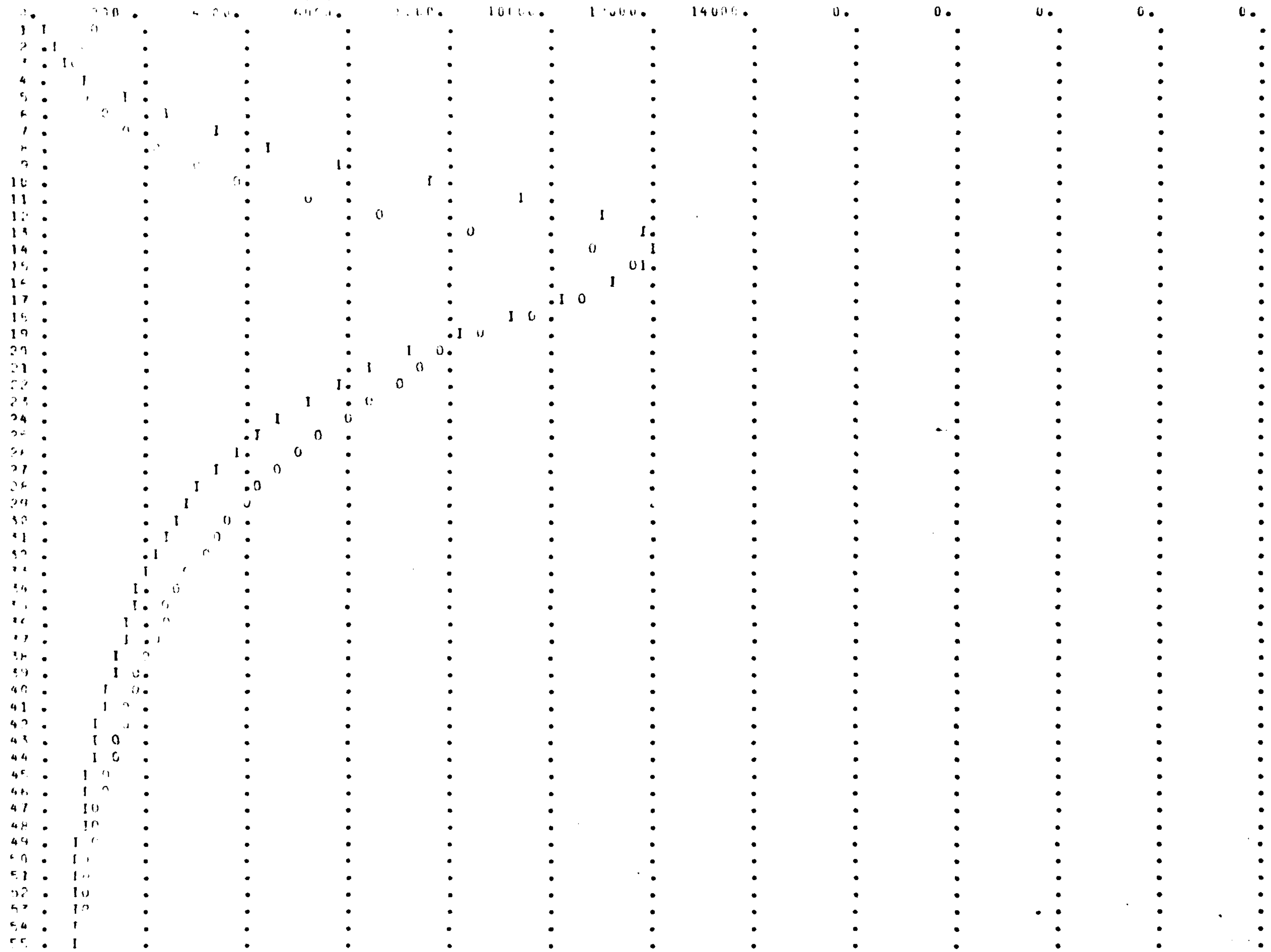
STORAGE=	248.	522.	792.	1066.	1350.	1638.	1932.	2232.	0.	0.
OUTFLOW=	2545.	3983.	5774.	7992.	15000.	31000.	57500.	90000.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	-40.	45.	901.
2	-69.	128.	744.
3	-82.	388.	671.
4	-74.	868.	711.
5	-43.	1557.	883.
6	12.	2378.	1188.
7	91.	3305.	1619.
8	195.	4429.	2191.
9	331.	5849.	2935.
10	501.	7516.	3868.
11	700.	9334.	5165.
12	906.	10901.	6688.
13	1083.	11807.	8359.
14	1185.	12088.	10889.
15	1211.	11846.	11538.
16	1200.	11146.	11272.
17	1170.	10173.	10526.
18	1132.	9147.	9590.
19	1093.	8154.	8616.
20	1052.	7245.	7864.
21	1001.	6435.	7457.
22	940.	5723.	6955.
23	875.	5124.	6441.
24	809.	4588.	5913.
25	745.	4120.	5459.
26	682.	3727.	5042.
27	621.	3382.	4642.
28	564.	3078.	4265.
29	511.	2806.	3924.
30	461.	2565.	3647.
31	413.	2346.	3385.
32	367.	2147.	3131.
33	324.	1983.	2897.
34	285.	1851.	2684.
35	250.	1729.	2490.
36	217.	1616.	2312.
37	187.	1505.	2148.
38	160.	1407.	1998.
39	135.	1317.	1860.

41	9.	1157.	1615.
42	71.	[illegible]	1607.
43	[illegible]	[illegible]	1407.
44	35.	952.	1515.
45	20.	892.	1329.
46	5.	836.	1149.
47	-6.	783.	1074.
48	-21.	733.	1005.
49	-33.	687.	940.
50	-44.	649.	881.
51	-53.	620.	826.
52	-62.	592.	780.
53	-70.	566.	736.
54	-77.	541.	697.
55	-84.	517.	660.
56	-90.	494.	626.
57	-96.	472.	595.
58	-101.	451.	566.
59	-106.	431.	538.
60	-111.	412.	513.
61	-115.	394.	489.
62	-119.	377.	466.
63	-123.	360.	444.
64	-127.	344.	424.
65	-130.	329.	405.
66	-134.	314.	386.
67	-137.	300.	369.
68	-140.	287.	352.
69	-143.	274.	336.
70	-146.	262.	321.
SUM			207258.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11538.	8850.	4069.	2961.	207258.
INCHES		4.72	8.67	9.20	9.20
AC-FT		4391.	8075.	8569.	8569.

INFLOW (I), OUTFLOW (O) AND INTERVAL FLOW(*)



[illegible] AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	[illegible]	[illegible]	[illegible]	2162.	1485.	[illegible].42
ROUTED TO	[illegible]	[illegible]971.	[illegible]	184[illegible].	1338.	6.42
HYDROGRAPH AT	[illegible]	1[illegible]20[illegible].	7[illegible]7.	2304.	1[illegible]80.	9.04
2 COMBINED	[illegible]	1[illegible]090.	9674.	4081.	[illegible]518.	17.46
ROUTED TO	[illegible]	11[illegible].	8[illegible]0.	4069.	[illegible]61.	17.46

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR. DIST.	STATE	COUNTY	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
RI	[illegible]	NED	[illegible]	[illegible]	01				PAWTUCKET RESERVOIR DAM	4158.9	7123.4	30NOV78

POPULAR NAME	NAME OF IMPOUNDMENT
ARNOLD MILLS RESERVOIR	PAWTUCKET RESERVOIR

REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
[illegible]	ABBOTT RUN	CUMBERLAND	0	26605

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
RECTPG	1928	S	33	33	5300	5125	NED	N	N	N	N	13DEC78

REMARKS

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	2900	U	151	6700												

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF PAWTUCKET	PAWTUCKET PUBLIC WORKS	JOHN J MCHALE + SONS

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
LOUIS BERGER + ASSOCIATES, INC.	27SEP78	PL92-367

REMARKS

DATE
ILMED
-8